

RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 57

SEPTEMBER, 1951

No. 3

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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Value of Soft-Tissue Technic in the Diagnosis and Treatment of Head and Neck Tumors¹

GILBERT H. FLETCHER, M.D., and KAROL E. MATZINGER, M.D.

THE PROGRESS in the management of malignant neoplasms of the head and neck has been brought about by a better understanding of the clinical aspects. It has also been demonstrated that a more accurate knowledge of the point of origin and extent of the tumor is necessary before any treatment is instituted.

The usual clinical methods remain the basis of the diagnosis but often they do not determine the true degree of extension of the lesion. In some instances, as in tumors of the nasopharynx, the most careful examination will fail to reveal the primary lesion, and in many cases of laryngopharyngeal tumors, the examination may be so difficult that it yields little information.

In 1922, Coutard (3) devised and developed the roentgenographic examination of the pharynx and larynx by means of a profile plate. Later on, the discovery of tomography furnished a complementary method.

The foreign radiological literature, mainly the French, has dealt extensively with the roentgenologic diagnosis of tumors of the soft tissues of the head and neck, but in this country the method has not met with widespread use, and it has been the subject of relatively few articles in the American radiological and otorhinolaryngological literature. A complete study of

the subject can be found in the classical treatises of Baclesse and Leborgne (1, 4). The present article does not claim to cover systematically all of the roentgenologic findings or to add any new ones to those described in previously published works (2, 5-7). Although the field of usefulness of the soft-tissue technic extends beyond malignant neoplasms, this paper will be limited to its application in such diseases, giving instances where roentgenologic study adduced information not obtainable by the clinical examination. The help of conventional or tomographic roentgenograms is invaluable in tumors of the paranasal sinuses and anterior oral cavity. These, however, will be excluded from this study, which will concern itself only with soft-tissue tumors and soft-tissue extensions.

The information obtained may be of four types:

- (1) Diagnosis of a tumor which escapes clinical observation. This applies primarily to tumors of the nasopharynx and of the pyriform sinus, and to subglottic tumors.
- (2) Determination of the degree of extension and clinical variety.
- (3) Aid in planning the x-ray treatment (mapping of the area to be treated and checking the accuracy

¹ Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10-15, 1950.



Fig. 1. Case B. B.

Clinical findings: Enlarged node on the right side of the neck. The node was biopsied and reported squamous-cell carcinoma, Grade IV. Examination of the nasopharynx showed a lesion on the right side. *Biopsy:* Lympho-epithelioma.

A. Lateral soft-tissue roentgenogram. Lateral soft-tissue views of the nasopharynx and films taken after instillation of lipiodol into the nares showed no definite findings.

B. Sagittal tomogram, demonstrating the tumor very clearly.

Comment: This case illustrates the incompleteness of a radiological examination of the nasopharynx without a sagittal tomogram.

of the location and size of the portals). This is of greater value since x-ray therapy machines are now equipped with light localizers which permit exact adaptation of the x-ray fields to the lesion.

- (4) Evaluation of the results of treatment by changes in the roentgenologic findings.

The material has been divided on the basis of the anatomic location, *i.e.*, nasopharynx, oropharynx, laryngohypopharynx, cervical esophagus, and thyroid.

TECHNICS

The interpretation of the roentgen findings rests on the evaluation of the density, size, and anatomical relationships of small soft-tissue structures. In order to diminish the causes of error, several principles

must be rigidly followed. The magnification must be reduced to a minimum by the use of a long target-screen distance (72 inches), and the distortion by precise aiming at the desired level (temporo-mandibular joint for the nasopharynx, angle of the jaw for the oropharynx, thyroid cartilage for the larynx). For a study of the oropharynx and laryngopharynx, two films must be taken at different levels. The patient is placed in a chair, the shoulder against the cassette holder, chin elevated and shoulders lowered. A long narrow cone is used. The factors are approximately 200 ma., 1/20 second, kv. ranging from 50 to 75 (from larynx to nasopharynx) depending upon the thickness of the part. One must adjust the technic to the individual equipment, using as a guide the fact that the bony parts (cervical vertebrae) should be barely dis-

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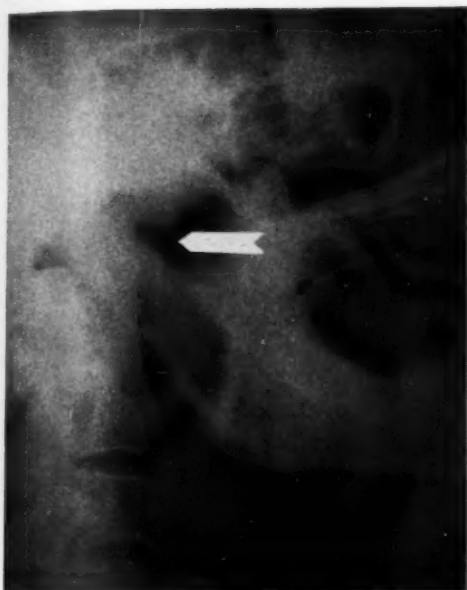


Fig. 2. Case E. G.

Clinical findings: Node back of sternocleidomastoid muscle. Partial excision showed squamous-cell carcinoma, moderately differentiated. Shortly before admission, paralysis of the lateral rectus muscle developed. A first examination by the otolaryngologist showed no evidence of primary lesion in the nose, nasopharynx, oropharynx, hypopharynx, or larynx.

Lateral soft-tissue roentgenogram, showing a small oval soft-tissue mass located at supero-posterior angle of the nasopharynx.

As a result of the x-ray findings, a second nasopharyngoscopic examination was done, revealing a soft-tissue mass having the appearance of adenoid tissue and obliterating the supero-posterior angle of the nasopharynx. This lesion was removed with small biopsy forceps and was reported squamous-cell carcinoma, undifferentiated.

Comment: Tumors of the nasopharynx frequently manifest themselves by the appearance of nodes in the neck. In the search for the primary lesion, a thorough roentgenologic examination of the nasopharyngeal area should be done, including lateral soft-tissue studies, films taken after instillation of lipiodol into the nares, and, eventually, sagittal tomograms.

cernible. With the new high kilovoltage technic, 100 kv. and around 2 ma. will give excellent soft-tissue details. The use of a long extension cone is then not necessary. This technic is to be preferred, if modern suitable equipment is available.

In addition to the lateral soft-tissue films, special views are required for the different sites. For the nasopharynx, after instillation of lipiodol in both nares, a



Fig. 3. Case H. P.

Clinical findings: Lesion involving base and left side of the tongue, tonsillar fossa, epiglottis, and left side of the pharyngeal wall. *Biopsy:* Squamous-cell carcinoma, Grade II.

Lateral soft-tissue roentgenogram showing a deeply infiltrating and ulcerating lesion of the base of the tongue involving the valleculae and epiglottis.

Comment: Palpation and examination with the mirror did not give adequate evaluation of the depth of the crater. This information, which was obtained only by lateral soft-tissue roentgenography, is of importance in determining the prognosis and treatment. Deeply ulcerating lesions are rarely cured by irradiation, and radical treatment is not justified.



Fig. 4. Case C. P.

Clinical findings: Hard mass occupying the posterior third of the tongue. No evidence of ulceration.

Biopsy: Poorly differentiated malignant tumor.

Lateral soft-tissue roentgenogram, showing a soft-tissue mass at the base of the tongue, with obliteration of the valleculae.

A tumor dose of 5,500 r, delivered in thirty-two days, was followed by clinical disappearance of the lesion.

Comment: The everted, exophytic tumors of the base of the tongue show a better response to radiation than the ulcerative, infiltrating variety.

film is taken with the patient lying on his back in hyperextension with his head against the cassette holder, the factors being the same as for plain soft-tissue films. For the laryngopharynx, films are also taken during the Valsalva maneuver and during the phonation of *a'*. For oropharynx and laryngopharynx, lateral and anteroposterior films are taken after ingestion of barium.

For tomograms of the larynx and pharynx the patient is placed in supine position with the chin raised. The sagittal plane of the neck must be exactly perpendicular to the table, as even a slight rotation would interfere with comparison of the pyriform sinuses. The exposure is made during a slow inspiration which opens the



Fig. 5. Case J. S.

Clinical findings: Deep crater in right vallecula with infiltration of pharyngo-epiglottic fold, ulceration of the free border of the epiglottis, and extension into the right aryepiglottic fold. *Biopsy:* Squamous-cell carcinoma, Grade III.

Lateral soft-tissue roentgenogram, showing a slightly ragged contour of the base of the tongue and valleculae. The degree of extension along the aryepiglottic fold is clearly seen.

Comment: Films help in the planning of the treatment by determining the position of the lower border of the x-ray portals.

glottis. The depths of the layers to be visualized are best selected from the lateral soft-tissue film. They can be measured by using the Adam's apple as a point of reference. The usual depths are 2, 3, and 4 cm. The factors are: anode film distance 40 inches, an average of 55 kv., 200 ma., and half a second. The angle of the movement of the tube is approximately 30 degrees.

NASOPHARYNX

Even small tumors of the nasopharynx often manifest themselves by such symptoms as involvement of the nerves of the base of the skull or metastases in the neck or at a distance. Not infrequently a most careful examination, both by direct and

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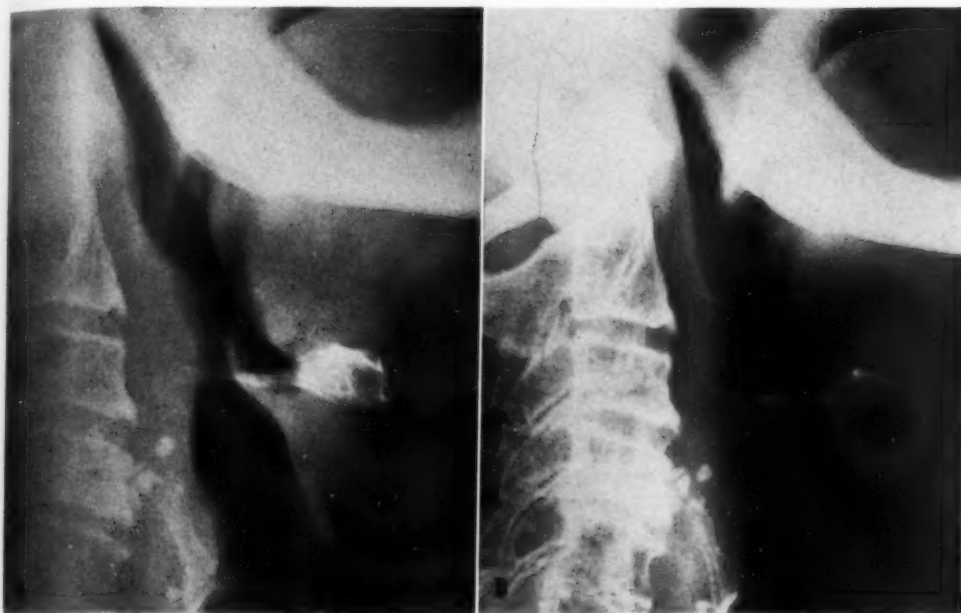


Fig. 6. Case M. D.

Clinical findings: Hard, infiltrating, non-ulcerating tumor involving the left tonsillar area, extending to the glossopalatine fold and the pharyngo-epiglottic fold, and infiltrating deeply into the lateral and posterior pharyngeal walls. *Biopsy:* Squamous-cell carcinoma.

A. Lateral soft-tissue roentgenogram, showing extension on the posterior pharyngeal wall downward below the tip of the horns of the thyroid cartilage.

A tumor dose of 8,800 r was given in seventy-two days, bringing about marked regression of the visible and palpable lesion.

B. Lateral soft-tissue roentgenogram after completion of treatment showing only a residual rippling of the surface of the posterior pharyngeal wall.

Comment: Clinically there was submucosal extension on the posterior pharyngeal wall, but one could not determine its lower limit. The roentgen examination was the only source of information as to the results of treatment on the lower infiltrating extensions.

indirect nasopharyngoscopy, will fail to show the tumor, more especially if it is primarily of the infiltrating type. The roentgen examination of the nasopharynx is not complete without a lateral soft-tissue film, a film after instillation of radiopaque material (lipiodol or thin barium) into the nares, and eventually sagittal tomograms (Fig. 1). By these radiographic means a small soft-tissue mass can be demonstrated, usually obliterating the normally sharp postero-superior angle of the roof of the nasopharynx (Figs. 1, 2).

The upward extension into the base of the skull can be demonstrated only by the submento-vertex view. The submucosal downward extension, into the oropharynx

and eventually the hypopharynx, is seen only in a soft-tissue profile film.

OROPHARYNX

Lateral roentgenograms enable one to visualize the base of the tongue, valleculae, aryepiglottic folds, pharyngo-epiglottic folds, and posterior pharyngeal wall. Small tumors at these sites can readily escape a careful clinical examination, and a small deformity of the base of the tongue, valleculae, and epiglottis can often be seen on the lateral soft-tissue film. The technic is more valuable in determining the degree and direction of the extensions of the disease and its clinical variety. For instance, the depth of ulceration of the tumor of the

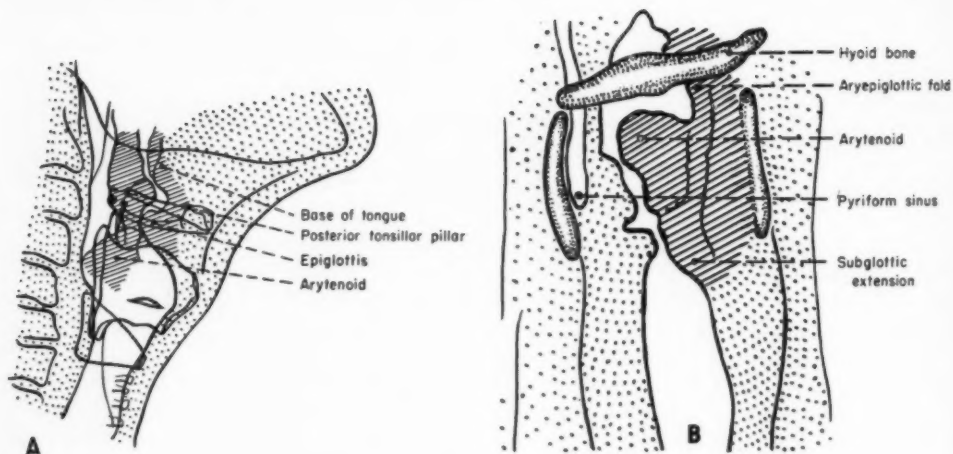


Fig. 7. Case C. J.

Clinical findings: Lesion involving the left tonsil and the left pharyngeal wall, with partial destruction of the epiglottis and marked swelling of the epiglottis and aryepiglottic fold. *Biopsy:* Squamous-cell carcinoma, Grade III.

A. Lateral soft-tissue roentgenogram showing extension of the lesion to the base of the tongue and valleculae, and destruction of the epiglottis with involvement of the lateral pharyngeal wall and arytenoid region.

B. Tomogram showing extensive invasion on the left of the aryepiglottic fold and ventricular band, with complete obliteration of the pyriform sinus. The hyoid bone is tilted upward on the left, which is indicative of extensive infiltration of the pre-epiglottic fossa.

Comment: Clinical examination could merely suggest invasion of the pyriform sinus. This was established with certainty only by the tomograms, which also demonstrated invasion of the pre-epiglottic fossa.

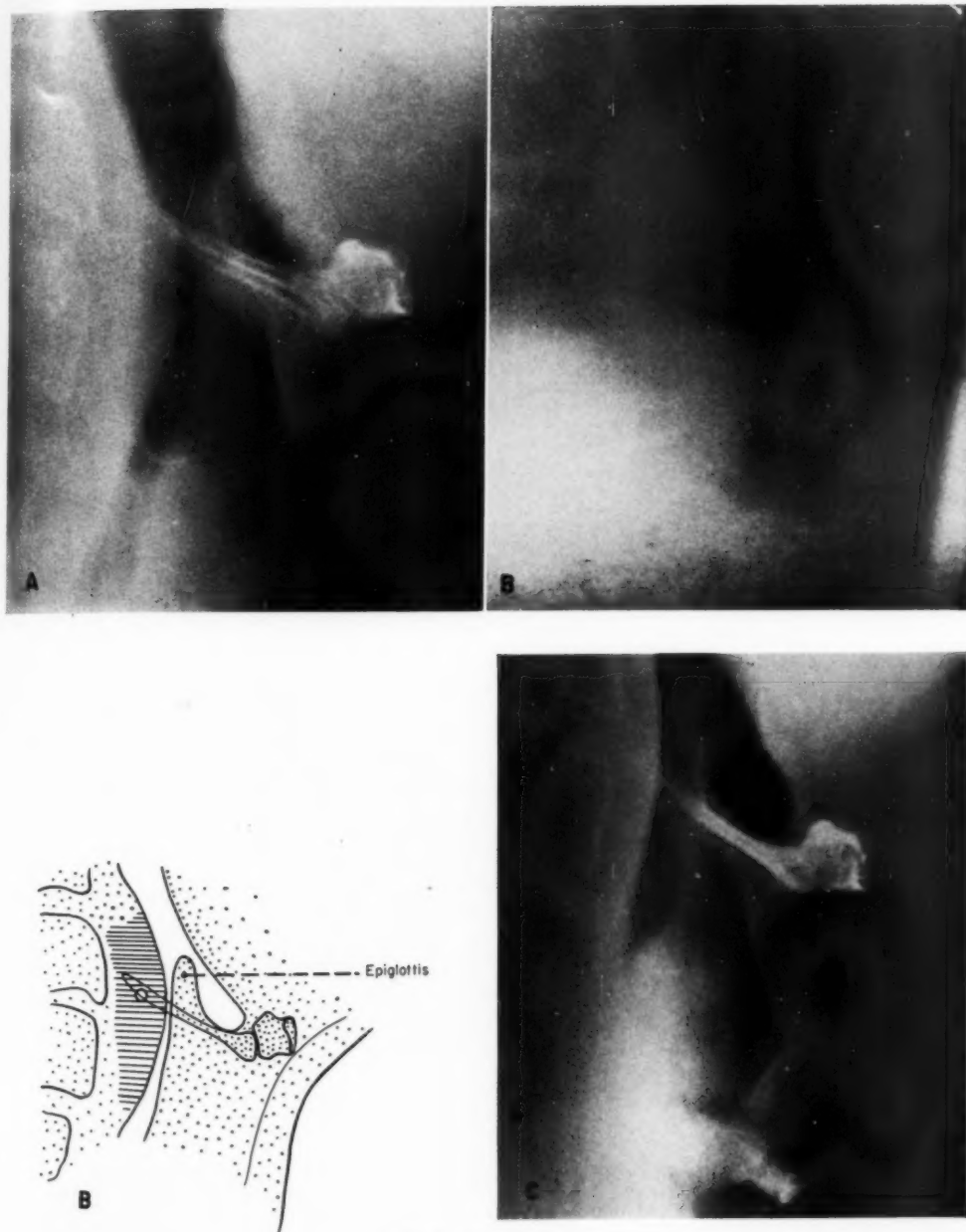


Fig. 8. Case J. D.

Clinical findings: Raised, ulcerated tumor occupying the entire posterior pharyngeal wall and extending several centimeters along the axis of the pharynx. *Biopsy:* Squamous-cell carcinoma, Grade IV.

A. Lateral soft-tissue roentgenogram, showing raised tumor with its maximum thickness at the level of the hyoid bone. There is good visualization of the upward and downward extension.

B. Film taken with the therapy machine to check accuracy of location of narrow fields (7×5 cm.).

C. Lateral soft-tissue film after completion of treatment (8,000 r tumor dose in sixty-five days), showing normal posterior pharyngeal wall. Clinical disappearance of ulceration is confirmed.

Comment: Roentgen examination, in this instance, was very useful for diagnosis of the exact extension, accurate positioning, and evaluation of treatment.

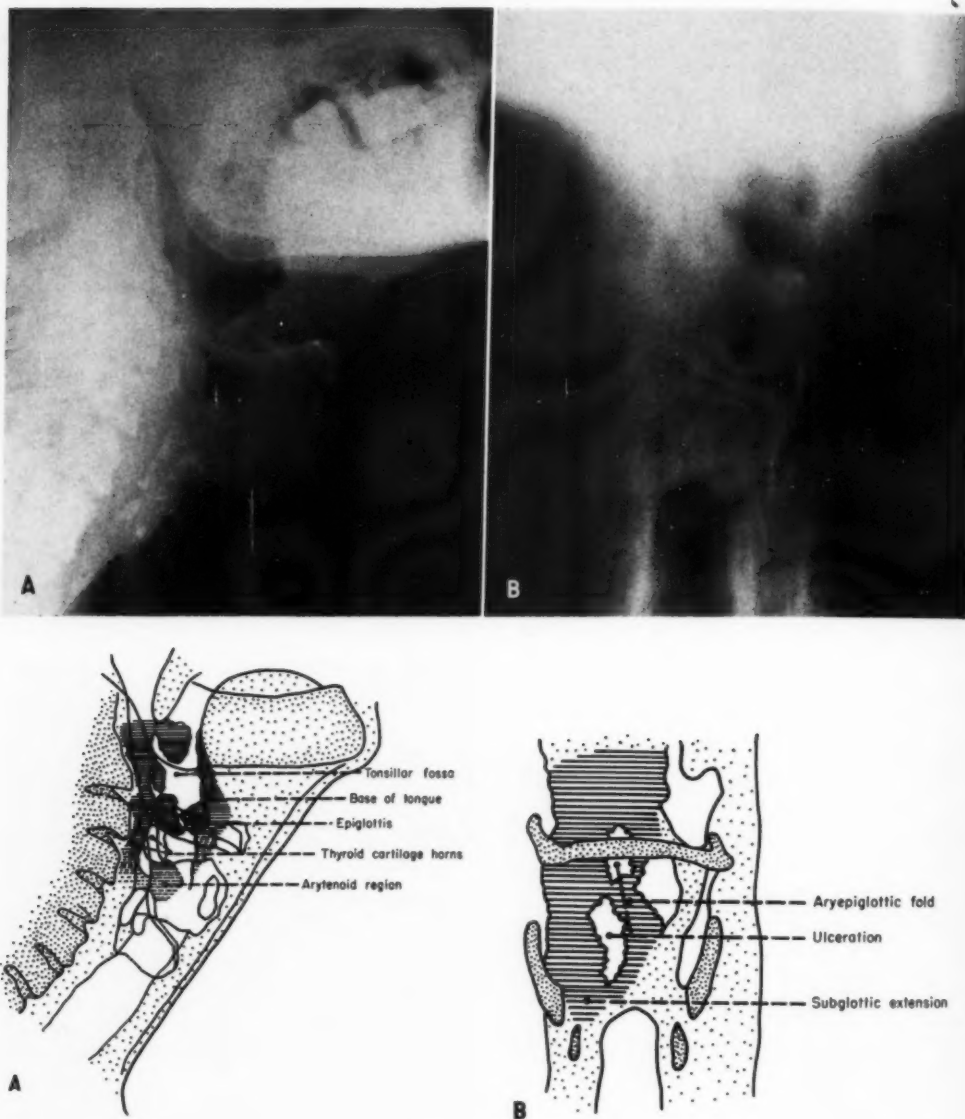


Fig. 9. Case B. K.

Clinical findings: A large fungating tumor involving the left tonsillar fossa, faucial pillars, and part of the base of the tongue and lateral pharyngeal wall as far as one could see. The epiglottis was much swollen, preventing visualization of the larynx and hypopharynx. Large matted nodes were present on the right side, and smaller isolated nodes on the left. **Biopsy:** Squamous-cell carcinoma, Grade III.

A. Lateral soft-tissue roentgenogram showing irregular polypoid soft-tissue masses at the level of the oropharynx and upper hypopharynx. There is a rippling at the base of the tongue; the epiglottis is barely defined, being apparently destroyed by the tumor. The aryepiglottic folds are also ill-defined and lost in the multiple soft-tissue masses. There is a thickening of the posterior pharyngeal wall with anterior displacement of one of the thyroid horns.

B. Tomogram. On the right there is a marked thickening of the aryepiglottic fold, right laryngeal structures, and almost complete obliteration of the pyriform sinus. These findings are indicative of tumor infiltration.

C (opposite page). The x-ray portal was mapped out on the skin, framed by metallic wire, and a film taken to determine whether the tumor, with all its extensions, was adequately covered.

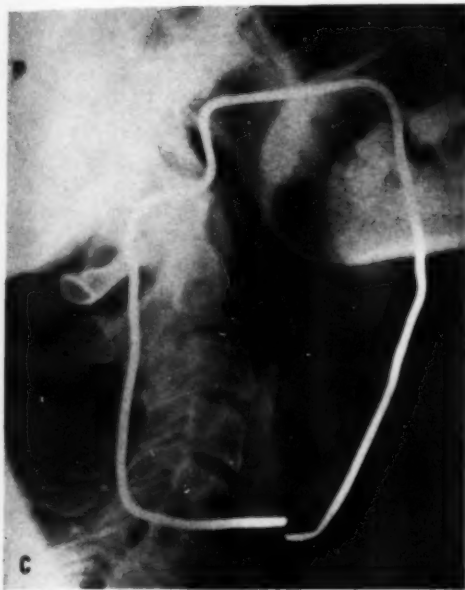


Fig. 9. Case B. K.

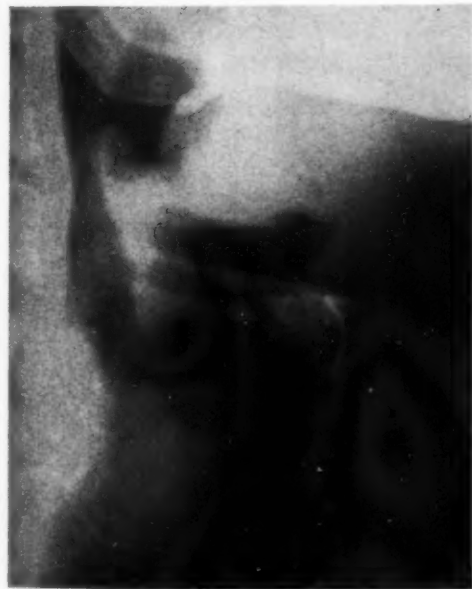


Fig. 10. Case R. G.

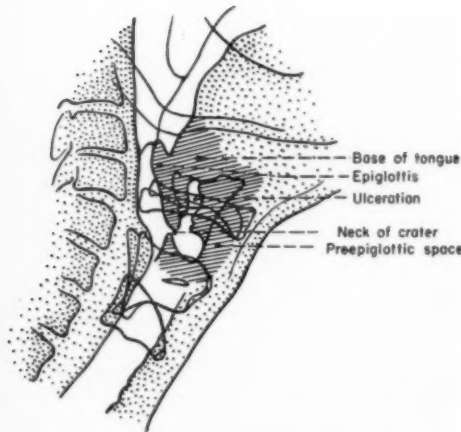
Clinical findings: Markedly thickened and distorted epiglottis with fixation of the right side of the larynx and considerable edema of the right arytenoid region. Palpation of the base of the tongue revealed hard infiltration. *Biopsy:* Squamous-cell carcinoma, Grade II.

Lateral soft-tissue roentgenogram showing thickening of the epiglottis with a large crater sectioning the epiglottis and penetrating deeply into the suprahyoid region of the pre-epiglottic fossa. The rippling of the base of the tongue in the region of the valleculae is suggestive of extension to that region.

Comment: The large penetrating crater through the epiglottis could not even be suspected on clinical examination. This finding precluded any surgical procedure and also any radical radiotherapeutic measures, as in such cases irradiation is always a failure.

base of the tongue cannot be well evaluated by either palpation or examination with a mirror. Soft-tissue studies demonstrate the crater with great clarity of detail (Fig. 3) and give valuable information as to the prognosis and the response to irradiation (Fig. 4). The deeply ulcerated tumors respond poorly and do not justify too radical a treatment. In tumors of the valleculae and suprahyoid epiglottis (Fig. 5), the profile plate will demonstrate the exact extension along the aryepiglottic folds and therefore help determine the size and exact location of the treatment fields.

In tumors of the tonsillar fossa, faucial pillars, and lateral and posterior pharyngeal wall, lateral soft-tissue films are useful in determining the extent of the lesion and the exact position and dimensions of the irradiation fields (Fig. 6). Occasionally tumors of the hypopharynx have



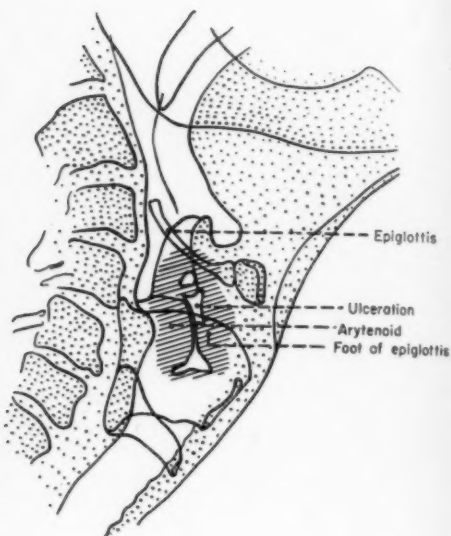


Fig. 11. Case J. S.

Clinical findings: Epiglottis shifted downward to the right. The left aryepiglottic fold and arytenoid region were markedly swollen and fixed. The endolarynx could not be well visualized. *Biopsy:* Squamous-cell carcinoma, Grade III.

Lateral soft-tissue roentgenography showed swelling of the aryepiglottic fold and arytenoid region with an ulceration on the laryngeal surface of the epiglottis.

Laryngectomy was done and examination of the surgical specimen revealed an extensive ulcerative lesion of the left aspect of the larynx, extending up to the epiglottis beyond the midline.

Comment: Neither direct nor indirect laryngoscopy could visualize the deep ulceration which indicated invasion of pre-epiglottic fossae, a finding of significance in prognosis as well as choice and planning of treatment.

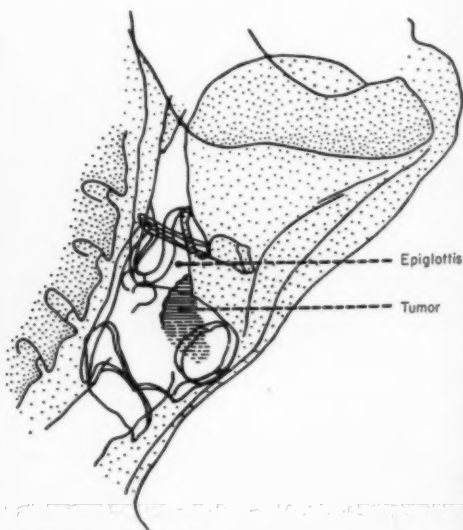


Fig. 12. Case G. T. (Legend on opposite page)

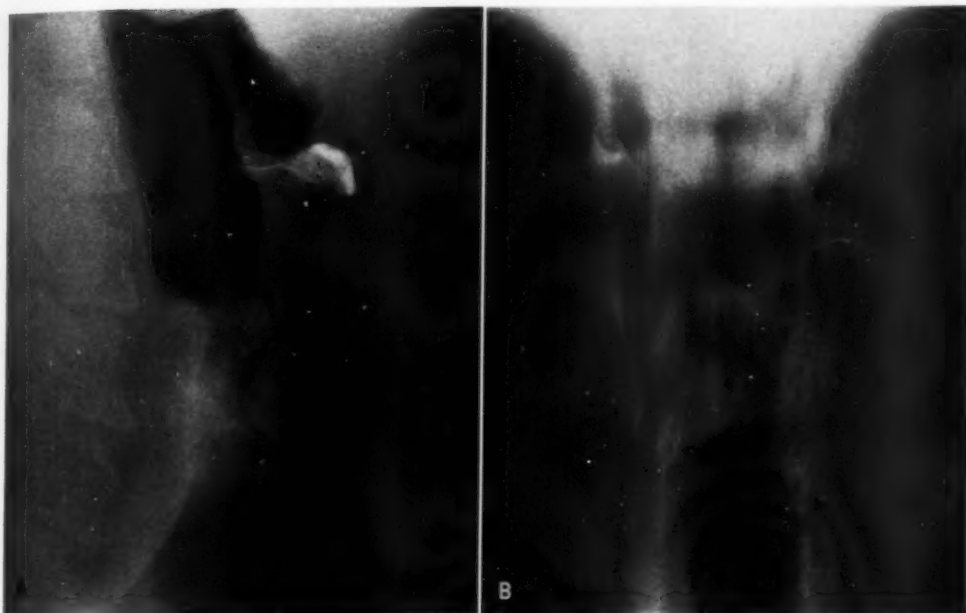


Fig. 13. Case G. Y.

Clinical findings: Marked swelling in the region of the right ventricular band and arytenoid region, extending upward into the aryepiglottic fold. There was apparently total fixation of the hemilarynx on this side. Neither cord could be visualized because of the overhanging character of the mass on the right. A 2.5-cm. node was present in the right anterior cervical chain at the mid-jugular level. *Biopsy:* Squamous-cell carcinoma, Grade III.

A. Lateral soft-tissue roentgenogram, showing opacity of the glottic lumen with lack of visualization of the foot of the epiglottis. No 8-shaped calcification can be seen on the anterior aspect of the thyroid cartilage.

B. Tomogram, showing involvement of the right ventricular band, ventricle, and vocal cord, with extension into the subglottic region. Pyriform sinuses clear.

Roentgenologic diagnosis: Tumor originating on right ventricular band with extensions as described and cartilage destruction.

Laryngectomy was done. The surgical specimen showed marked distortion in the region of the right vestibule, with involvement of the ventricular band, the ventricle, and the vocal cord. This distortion consisted of a large area of ulceration, 23 mm. in length and 8 mm. in width, involving the foot of the epiglottis and completely destroying this section of the epiglottis. A probe was passed 5 mm. into this ulceration. Immediately outside of the ulcerated area were raised, rolled edges of yellowish-white mucosa that appeared to be involved in a tumor process similar to that seen at the base of the ulcer. The area of ulceration extended 8 mm. below the labium of the vocal cord and to within 18 mm. of the first tracheal ring.

Microscopic examination confirmed the cartilage destruction and the subglottic extension. Several nodes were involved.

Comment: The roentgen examination established the site of origin at the supraglottic level and determined accurately the extension of the tumor.

spread so extensively into the oropharynx that this extension is the only one seen on clinical examination (Fig. 7). In order to check the adequacy of the fields, films can

be taken either with the therapy machine in the actual treatment position (Fig. 8) or with the diagnostic machine, after framing the skin markings with wire (Fig. 9).

Fig. 12. Case G. T.

Clinical findings: Mass 2.5 cm. in its greatest diameter on the laryngeal surface of the epiglottis, with extension to the right along the ventricular band. Both cords moved normally. *Biopsy:* Anaplastic squamous-cell carcinoma.

Lateral soft-tissue roentgenography showed an oval mass, the base of which is on the epiglottis. The foot of the epiglottis blends with the mass. Normal 8-shaped calcification is present.

On laryngectomy a 28 × 18-mm. mass was found on the laryngeal surface of the epiglottis. Sections show that the tumor does not extend through the thyroid cartilage.

Comment: The roentgen examination suggested an essentially exophytic, non-infiltrating tumor, without cartilage destruction. These lesions are usually locally radiocurable.

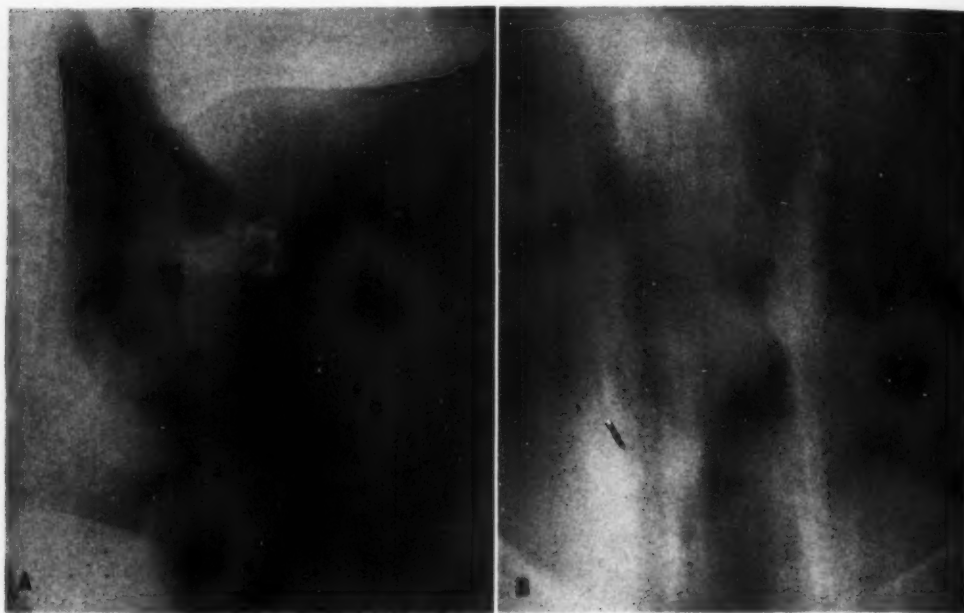


Fig. 14. Case T. C.

Clinical findings: Patient referred, after x-ray therapy five months previously, for persistent papillomatous lesion on the posterior third of the right cord, with an edematous swelling of the arytenoid region, the right pyriform fossa, and the right side of the epiglottis. *Biopsy:* Squamous-cell carcinoma, Grade III.

A. Lateral soft-tissue roentgenogram, showing thickening of the foot of the epiglottis, a suggestion of cartilage destruction and subglottic extension.

B. Tomogram showing swelling of the aryepiglottic fold and ventricular band, obliteration of the pyriform sinus, excavation of the ventricle, probable invasion of the alae of the thyroid cartilage, and marked enlargement of the vocal cord, with definite subglottic extension.

Laryngectomy was done. The specimen showed tumor occupying the anterior and central parts of the right vocal cord, extension into the right ventricle, with ulceration into the pyriform fossa, which was filled with tumor invading the thyroid cartilage. Inferiorly the tumor extended into the subglottic tracheal region.

Comment: Both the lateral soft-tissue films and the tomograms contributed information that could not be obtained by clinical examination, that is to say, definite invasion of the pyriform sinus, the distortion and invasion of the ventricle, and probability of cartilage destruction.

Roentgenograms following therapy are of great help in evaluating the results achieved, in particular with regard to the infiltrating extensions (Figs. 6 and 8).

LARYNX AND HYPOPHARYNX

The exact determination of the primary site of origin of a lesion of the larynx or hypopharynx and an accurate knowledge of its extensions are of more than academic significance. In the last twenty-five years, considerable experience has been acquired in this field, so that now this information is of real practical value. Often it is the basis upon which one decides if radiotherapy or surgery, or both, should be used. The information is of further help, once the

method of treatment has been decided, in the planning either of radiotherapy or the surgical procedure.

The widely used classification of extrinsic and intrinsic as applied to laryngeal lesions cannot give a basis for such a study as this. We will use instead the French classification, which is anatomic and refers to the primary site of origin of a lesion regardless of its subsequent extension. This classification subdivides an endolaryngeal cancer as (a) supraglottic (ventricles, false cords, infrahyoid epiglottis); (b) glottic, that is to say, originating on the superior surface or free margin of the true cords; (c) subglottic, originating on the lower surface of the vocal cords or on the

Clinical findings: Patient referred, after x-ray therapy five months previously, for persistent papillomatous lesion on the posterior third of the right cord, with an edematous swelling of the arytenoid region, the right pyriform fossa, and the right side of the epiglottis. Biopsy: Squamous-cell carcinoma, Grade III.

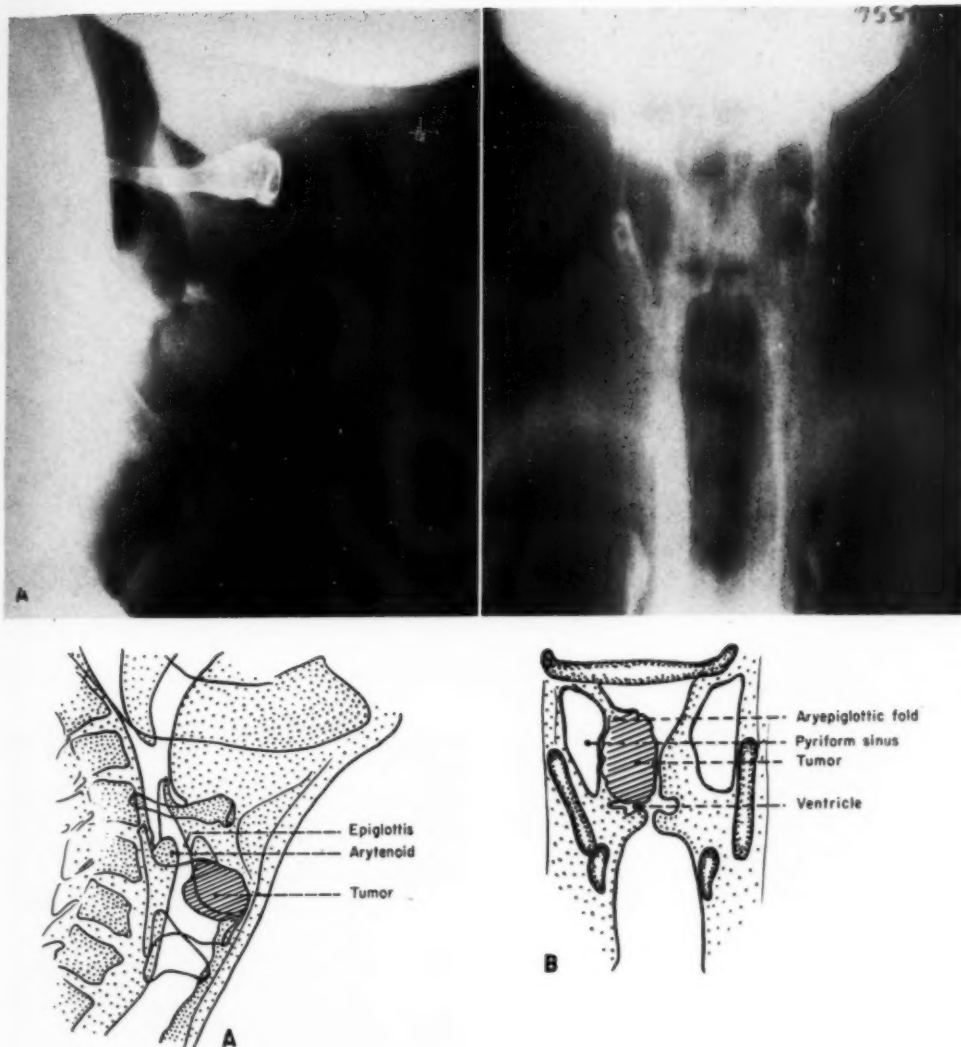


Fig. 15. Case J. B.

Clinical findings: Laryngoscopy (direct and indirect) showed a bulky tumor filling the laryngeal space. It was the impression of the examiner that this was an extensive cord tumor with fixation of both cords, particularly on the left, and probable subglottic extension. *Biopsy:* Squamous-cell carcinoma, Grade IV.

A. Lateral soft-tissue roentgenography showed opacity of the anterior two-thirds of the laryngeal lumen at the supraglottic level. The foot of the epiglottis is lost in the tumor mass.

B. Tomogram showing a tumor on the right ventricular band, normal vocal cords, and no invasion of the pyriform sinus or aryepiglottic fold.

A tumor dose of 6,200 r was given in forty-four days. At the completion of treatment, the glottic lumen was free from tumor and good visualization was obtained of both cords, which were seen to be uninvolved and freely movable.

Comment: In this instance, the diagnosis of the exact location at the lesion at the supraglottic level was made only by the tomograms. This had considerable bearing upon the prognosis and method of treatment, as these tumors differ markedly in behavior from tumors originating on the vocal cord.

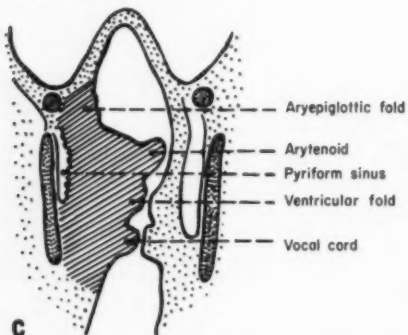
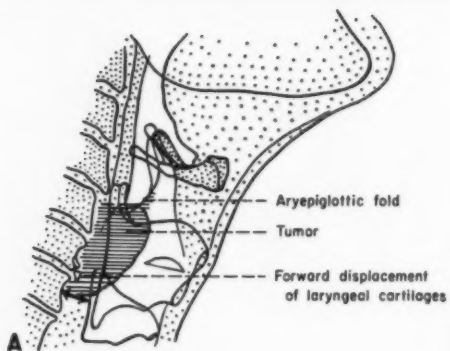
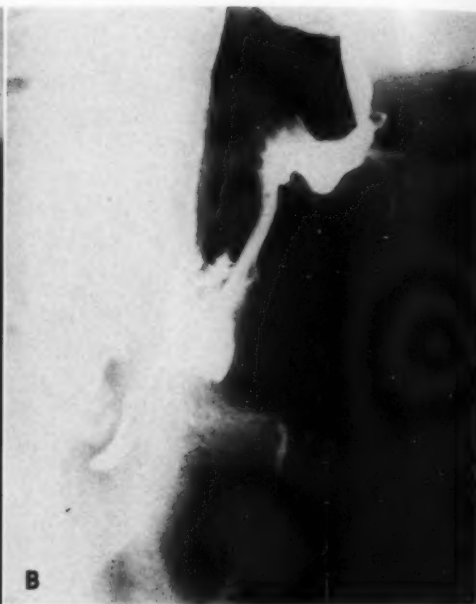
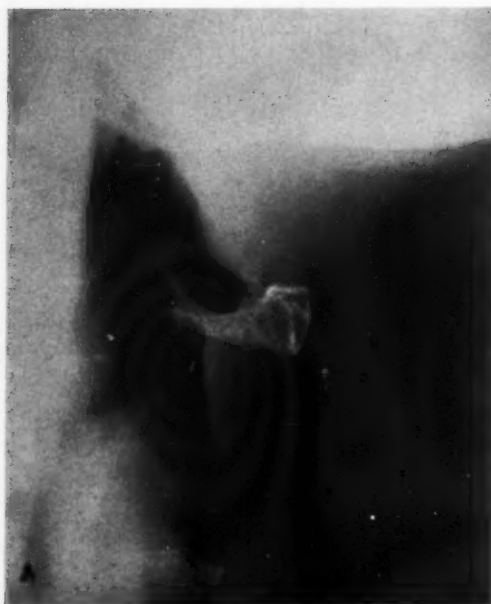


Fig. 16. Case J. T. (Legend on opposite page)

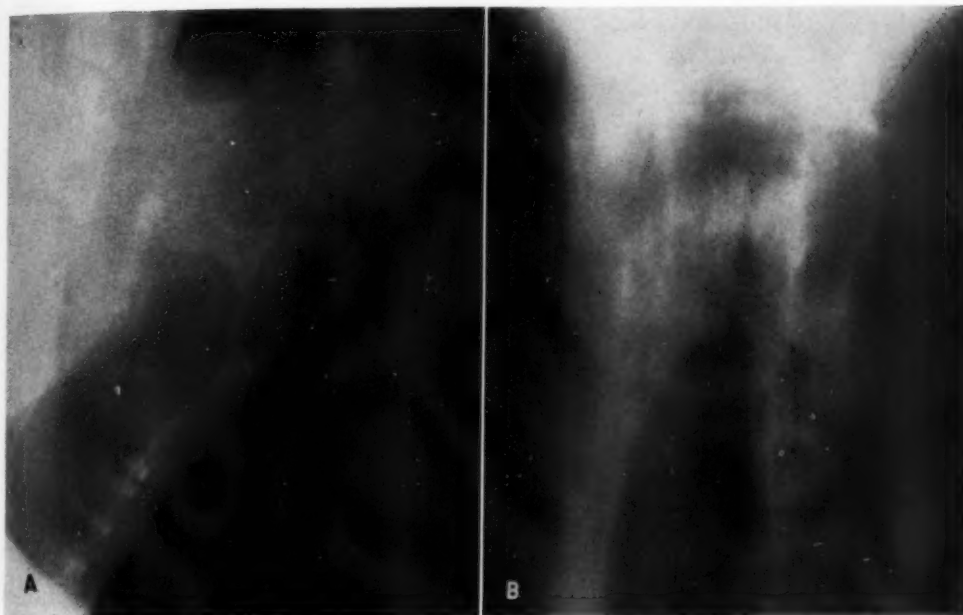


Fig. 17. Case R. H.

Clinical findings: Laryngofissure had been done two years previously for a lesion invading the right vocal cord and commissure. Indirect mirror examination showed edema above the cords on both sides. The left cord was not seen, having apparently been removed entirely at the time of laryngofissure. The right cord was apparently normal. No evidence of active disease.

A. Lateral soft-tissue roentgenogram, showing ill-defined opacity over the glottic area.

B. Tomogram, showing definite widening of the left hemilarynx with thickening of the false cord, obliteration of the pyriform sinus, and definite blunting of the angle below the left vocal cord level. The radiologic diagnosis was recurrent tumor with invasion of the supraglottic level, pyriform sinus, and subglottic extension.

Because of these findings, a total laryngectomy was performed. From the gross and microscopic descriptions, it was seen that the tumor probably arose in the glottic area itself and had extended downward into the subglottic area and upward into the supraglottic structures, including the pyriform sinus. Checking of the resected margin in the region of the pyriform sinus revealed tumor immediately adjacent to the resected edge.

Comment: In this instance the radiologic examination was the only source of positive information.

trachea. Tumors originating on the suprahyoid epiglottis, the laryngeal surface of the aryepiglottic fold, and the arytenoid region, form an epilaryngeal group.

The hypopharyngeal tumors are (a) those originating high on the aryepiglottic fold on the pyriform sinus side; (b) those originating at the bottom of the pyriform

Fig. 16. Case J. T.

Clinical findings: Patient referred with diagnosis of lesion of the upper cervical esophagus. Direct and indirect laryngoscopy showed moderate edema of the lower part of the right aryepiglottic fold and right arytenoid region, with diminished mobility of the latter and the right cord. *Biopsy:* Squamous-cell carcinoma, Grade IV.

A. Lateral soft-tissue roentgenography showed slight anterior displacement of one of the posterior horns of the thyroid cartilage and an enlarged arytenoid, with suggestion of thickening of one of the aryepiglottic folds.

B. A lateral film, after a barium swallow, showed a partial obstruction at the level of the cricopharyngeal muscle and upper esophagus, apparently due to extrinsic pressure.

C. Tomogram, showing almost complete obliteration of the right pyriform sinus, with marked infiltration of the laryngeal structures extending upward into the aryepiglottic fold.

The radiologic diagnosis was primary tumor in the pyriform sinus with invasion of the structures described.

A panlaryngectomy, cervical esophagectomy, and right radical neck dissection in continuity were performed. The operative specimen showed a tumor of the right pyriform sinus protruding into the hypopharyngeal lumen and involving the right arytenoid, the aryepiglottic fold, and the ventricular band.

Comment: The radiological examination corrected the initial clinical diagnosis of a tumor of the upper cervical esophagus. The usual clinical examination showed, as is often the case in pyriform sinus tumors, only the edema and enlargement of the arytenoid region and aryepiglottic fold. The anterior displacement of one of the horns of the thyroid cartilage was suggestive of a pyriform sinus tumor. This was substantiated by the obliteration of the sinus on the tomograms. The combination of lateral soft-tissue films, lateral film after ingestion of barium, and tomograms determined with complete accuracy all the extensions of the tumor.

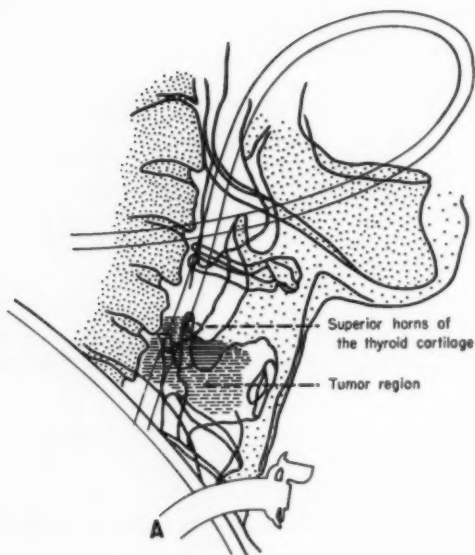
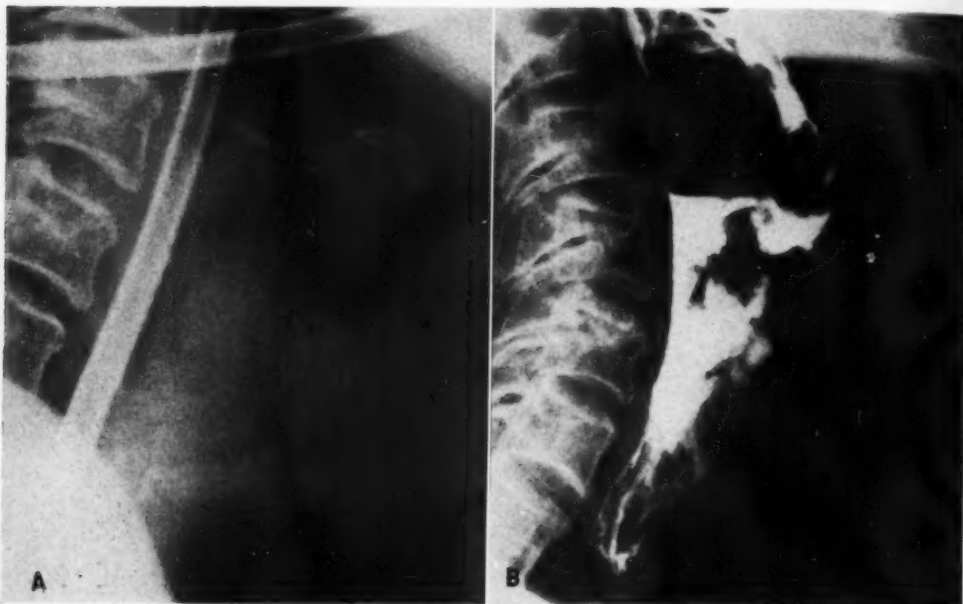


Fig. 18. Case W. D.

Clinical findings: Obliteration of the right pyriform sinus with apparent involvement of the base of the aryepiglottic fold and sufficient bulging over the glottic lumen so that neither cord could be visualized. **Biopsy:** Poorly differentiated carcinoma, Grade IV.

A. Lateral soft-tissue roentgenogram showed swelling of the arytenoid and aryepiglottic fold, with anterior displacement of the horns of the thyroid cartilage.

B. Lateral film, after ingestion of barium, showing irregular filling of the hypopharyngeal structures and

an elongated soft-tissue mass extending for several centimeters downward, giving a pressure effect on the barium stream and impinging upon the posterior wall of the trachea.

C (opposite page). Tomogram showing obliteration of the pyriform sinus on the right with probable invasion of the alae of the thyroid cartilage. It also demonstrates the marked involvement of the aryepiglottic fold, ventricular band, true cord, and a certain degree of subglottic extension.

Laryngectomy was performed. The operative specimen showed the entire right side of the larynx, pyriform fossa, and surrounding areas occupied by a large tumor measuring about 6 cm. in the supero-inferior direction and 4 cm. in the lateral direction. The posterior wall of the trachea was replaced by tumor.

The tumor protruded into the hypopharynx and dipped into the lumen of the esophagus. There was also involvement of the foot of the epiglottis and subglottic region. The thyroid cartilage was grossly involved anteriorly and, on microscopic examination, there was extensive invasion of the right ala.

Comment: The radiologic examination revealed very accurately all of the extensions of the lesion.

sinus; (c) those originating on the posterior surface of the hypopharynx above the cricoid region; (d) the true retrocricoid tumors.

The clinical examination of the larynx and pharynx is often limited by a swollen overhanging epiglottis, markedly edematous arytenoid region, and exophytic masses obliterating the laryngeal lumen or the hypopharynx. In such instances, the exact location, the topographic involve-

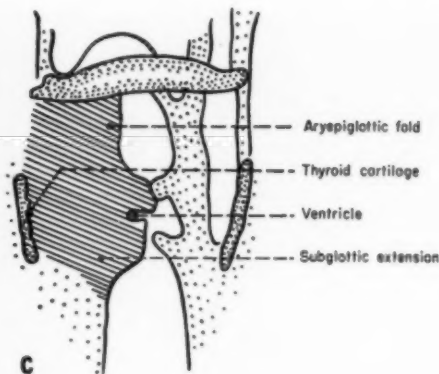


Fig. 18. Case W. D.

(See preceding page)

ment, and routes of extension of the lesion are not demonstrable. Even with good visibility of the laryngeal lumen, ulcerations of the epiglottis, invasion of the pre-epiglottic fossa or of the bottom of the pyriform sinus, cartilage destruction, and often subglottic extensions, may be missed. The degree of downward extension in the prevertebral fasciae behind the larynx and in the lower cervical region cannot be determined clinically.

The roentgenologic examination includes lateral soft-tissue films taken in normal inspiration, with the phonation of *a'*, in the Valsalva maneuver, and after a swallow of barium. The examination is not complete without frontal tomograms.

The lateral roentgenograms demonstrate the hyoid bone, the pre-epiglottic fossa, the laryngeal surface and the foot of the epiglottis, the arytenoid soft-tissue mass, the aryepiglottic folds, the hyaline cartilages of the larynx with their calcifications and, in the most favorable instances, the ventricles with the true and false cords. The film taken during the phonation of *a'* shows the ventricles more clearly, and the film taken during the Valsalva maneu-

ver, on a normal subject, reveals an open retrolaryngeal space.

Profile plates are most valuable for demonstrating those tumors in which the development is primarily in the sagittal plane, such as tumors of the glottic region, tumors of the laryngeal surface of the epiglottis or foot of the epiglottis (with or without extension to the pre-epiglottic space) (Figs. 10-13), tumors of the arytenoid region, and tumors extending along the aryepiglottic folds. Absence of an 8-shaped type of calcification on the anterior aspect of the thyroid cartilage (Fig. 13), particularly in men over fifty, is almost pathognomonic of cartilage destruction. The moth-eaten appearance of the calcifications on the alae is sometimes suggestive (Fig. 14) of neoplastic invasion. Posteriorly, anterior displacement of the horns of the thyroid cartilage is indicative of pyriform sinus tumors, tumors of the posterior wall of the hypopharynx, and laryngeal tumors which have spread to the prevertebral fasciae (Figs. 16, 18-21).

Tomograms show the laryngeal funnel, the ventricular bands, ventricles, true cords, subglottic space, aryepiglottic folds, pyriform sinus, and alae of the thyroid cartilage. They help determine the level (Figs. 13 and 15) of the tumor and the extension in the frontal plane, demonstrating distortion of the cords, ventricles, ventricu-

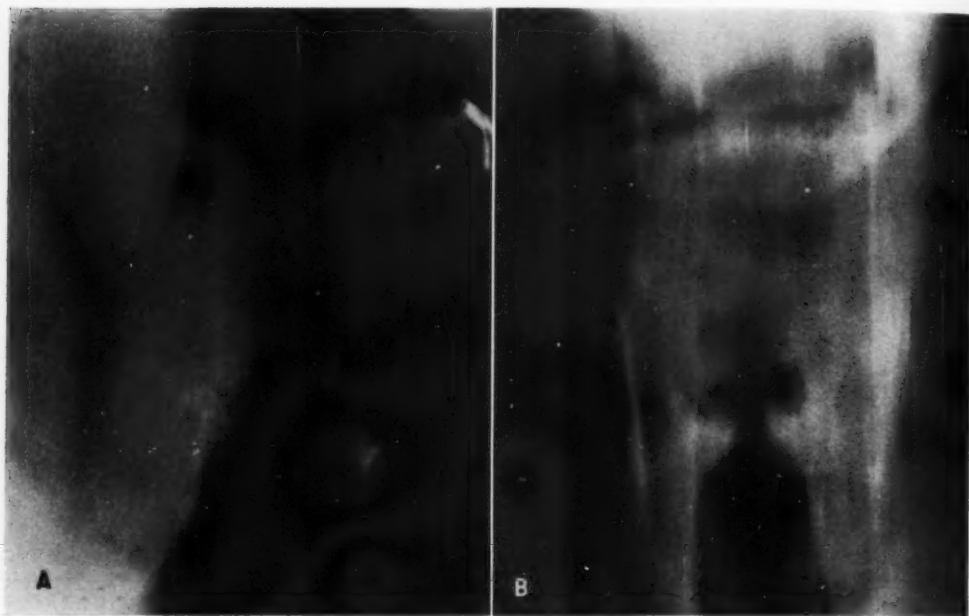


Fig. 19. Case J. B.

Clinical findings: Right side of the larynx and pharynx normal. The left aryepiglottic fold was displaced by a tumor approximately 2.5 cm. in diameter which occupied practically the entire laryngeal inlet. It completely obscured any view of the more inferior structures. There was a node 1.5 cm. in diameter in the carotid region.

Biopsy: (1) Fibrosarcoma (from the primary); (2) poorly differentiated carcinoma (from the neck nodes).

A. Lateral soft-tissue roentgenography showed a large, smooth mass filling the pharynx practically all along the length of the epiglottis, apparently pedunculated, arising from the markedly widened postlaryngeal space. One of the horns of the thyroid cartilage is displaced anteriorly.

B. Tomogram. On the left, there is marked widening of the left hemilarynx with obliteration of the pyriform sinus.

Radiological diagnosis: Unusually exophytic tumor originating in the pyriform sinus.

A panlaryngectomy and upper cervical esophagectomy, with radical neck dissection on the left, was performed. Examination of the surgical specimen revealed, after transection, a very large fungating tumor distorting the left hemilarynx. The major part of the tumor came from the pyriform sinus and the aryepiglottic fold.

Final histological diagnosis: Spindle-cell carcinoma.

Comment: Clinical examination could not give any information as to the exact origin of the tumor, and only the lateral soft-tissue roentgenograms and tomograms demonstrated that it arose in the pyriform sinus. It was on the basis of this diagnosis that surgery was decided upon.

lar bands and aryepiglottic folds, obliteration of the pyriform sinus, and destruction of the alae of the thyroid cartilage.

The subglottic extension of cord tumors is often missed by the laryngoscopic examination, and its extent inadequately evaluated. In these instances, tomograms are an invaluable source of essential information as to the choice and planning of the treatment (Figs. 14 and 17). In tumors of the aryepiglottic fold and pyriform sinus, tomograms will often be the only means of determining the exact location of the primary site. On laryngoscopy,

the only finding is swelling of the arytenoid region and aryepiglottic fold. This prevents any vision of a neoplasm which has originated at the bottom of the pyriform sinus and has infiltrated deeply without producing either ulceration or visible tumor at a higher level (Fig. 16). Obliteration of the pyriform sinus is almost pathognomonic of a tumor at this site. It is often associated with distortion of the ventricle and ventricular band, and partial involvement or total destruction of the alae of the thyroid cartilage (Figs. 16, 18-21). Tomograms are invaluable in differentiating between

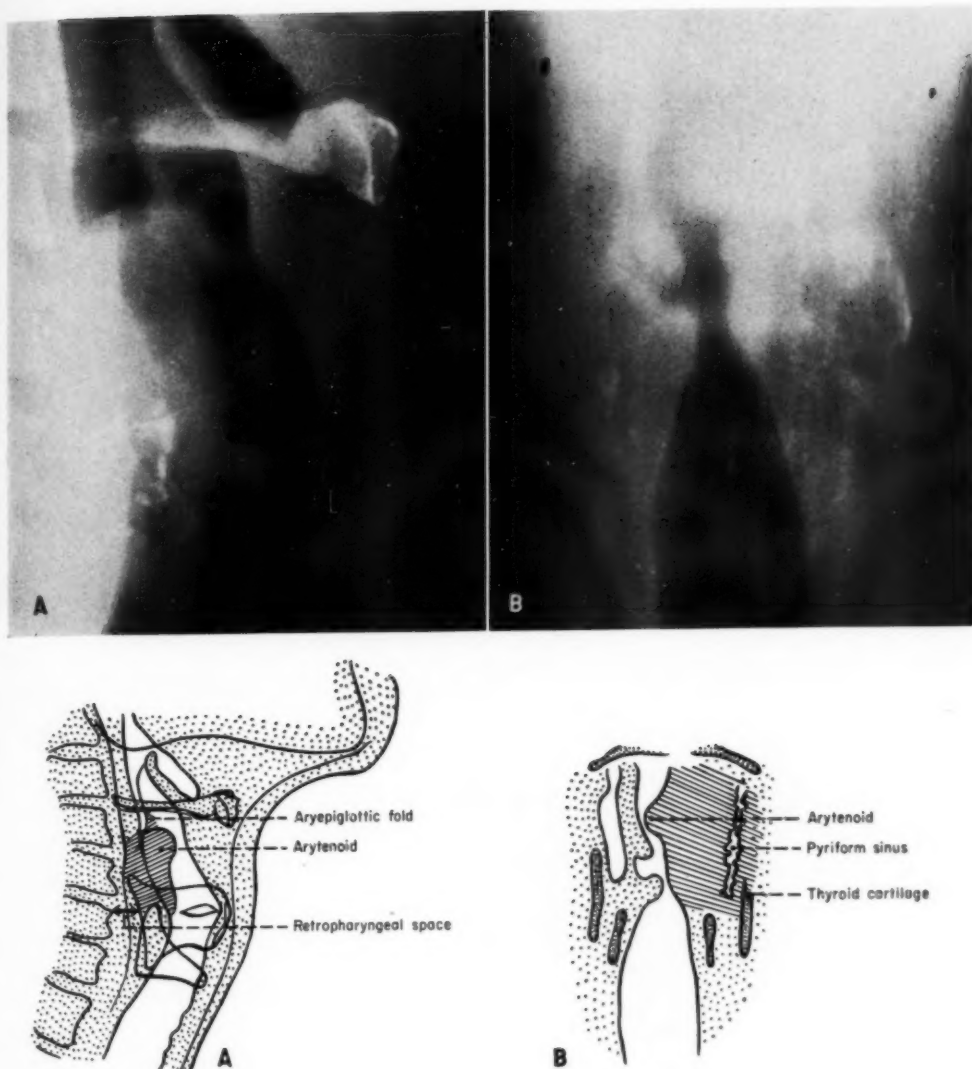


Fig. 20. Case H. B.

Clinical findings: Ulcerating fungating lesion on the left of the aryepiglottic fold, pyriform fossa, and lateral pharyngeal wall. The arytenoid region was fixed and edematous. *Biopsy:* Squamous carcinoma, Grade III.

A. Lateral soft-tissue roentgenography showing swelling of the aryepiglottic fold and arytenoid region with marked anterior displacement of one horn of the thyroid cartilage.

B. Tomogram showing complete obliteration of the pyriform sinus on the left, with marked swelling of the aryepiglottic fold, ventricular band, ventricle, and vocal cord. There are some subglottic extension and suggestion of destruction of the alae of the thyroid cartilage adjacent to the pyriform sinus.

A tumor dose of 6,500 r was given in fifty-one days. Two and a half months after completion of therapy, a panlaryngectomy and partial pharyngectomy was performed. On the operative specimen no tumor was identified in the laryngeal structures, including the pyriform sinus, which was filled with necrotic material. Cartilage destruction of the alae was present.

Comment: The tomograms demonstrated the involvement of the bottom of the pyriform sinus, identifying the tumor as a true pyriform sinus tumor. It also demonstrated the cartilage destruction.

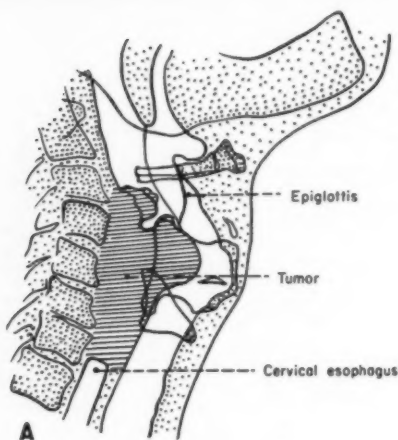
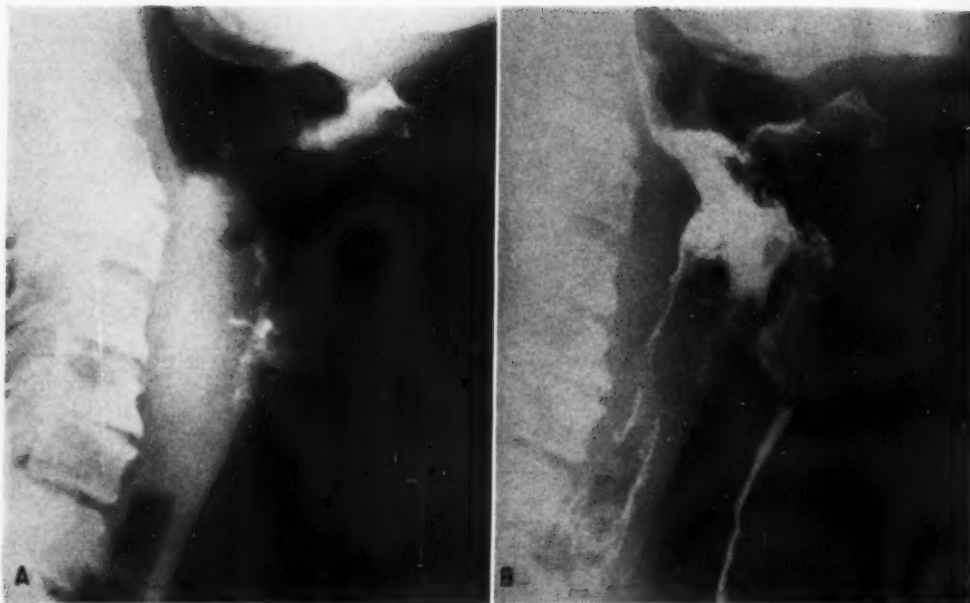


Fig. 21. Case J. B.

Clinical findings: Laryngoscopy showed considerable destruction of the epiglottis, a large penetrating crater involving the lateral pharyngeal wall on the left and extending into the left pyriform sinus. The left hemilarynx was totally fixed. Huge, matted nodes were present in the upper left carotid region and behind the sternocleidomastoid muscle. *Biopsy:* Squamous-cell carcinoma, Grade III.

A. Lateral soft-tissue roentgenography showing marked edema and swelling of the arytenoid with a large posterior soft-tissue mass displacing the larynx anteriorly and extending downward, displacing the trachea. The extensive mottling of the calcification of the thyroid alae is strongly in favor of cartilage involvement.

B. After a swallow of barium, a narrowing of the upper cervical esophagus was demonstrated, as well as an anterior displacement of the barium stream at the level of the pharynx, indicative of marked involvement of the posterior pharyngeal wall.

See also C and D, opposite page.

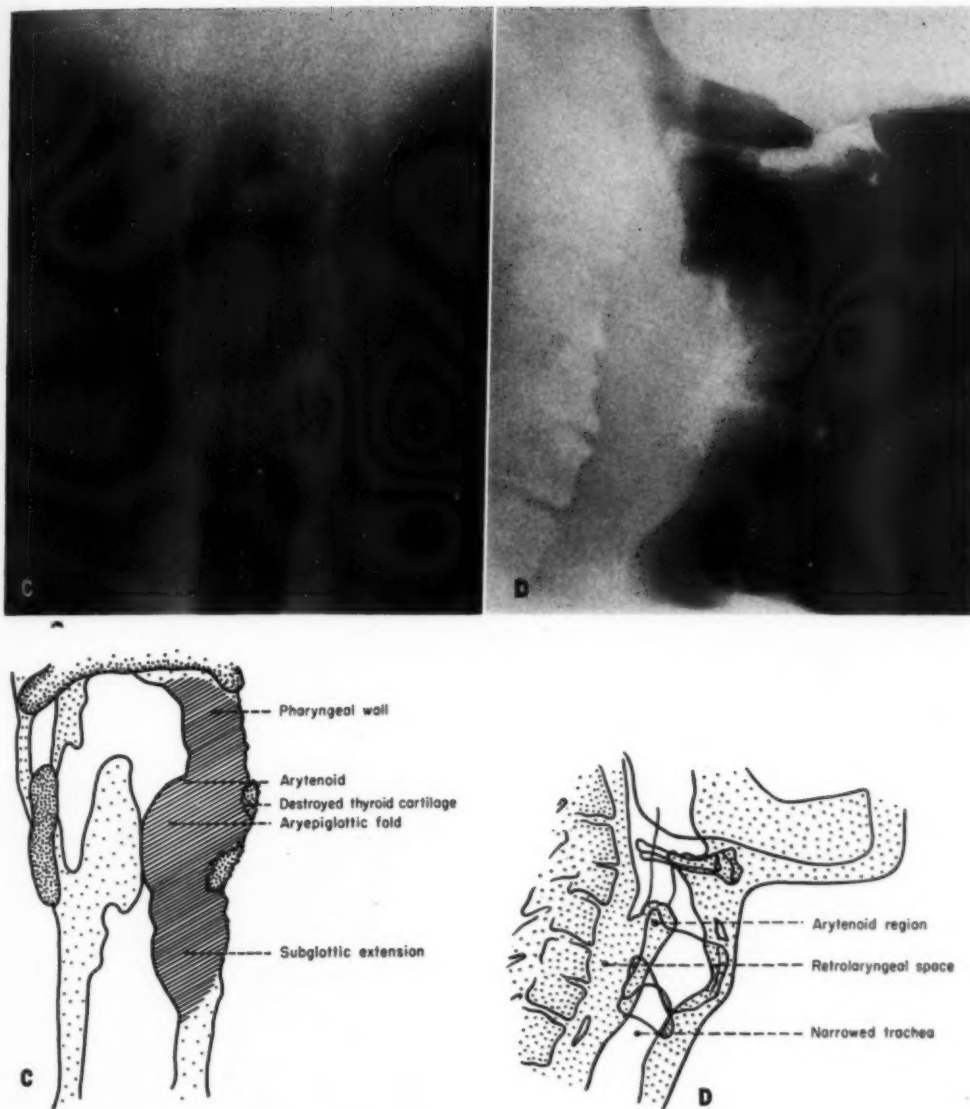


Fig. 21. Case J. B.

C. Tomogram showing obliteration of the left pyriform sinus, with complete destruction of the cartilage of the thyroid alae and downward extension into the subglottic region.

A tumor dose of 7,200 r in fifty-six days to the primary site and 7,000 r to the nodes on the left brought about a considerable regression of the lesion, with apparent healing of the visible aspects of the pharynx and larynx and also disappearance of the nodes. Later on, nodes appeared in the right supraclavicular region.

D. Lateral soft-tissue roentgenography at completion of treatment showed slight shrinking of the prevertebral extension, but the residual thickness suggests that there is still active disease in the lower neck.

The patient eventually died from invasion of the lower cervical esophagus and trachea.

Comment: The roentgen examination demonstrated: (a) the posterior pharyngeal extension, (b) the extension downward along the prevertebral tissues in the lower cervical region, (c) the extensive cartilage destruction to the thyroid alae, (d) the subglottic involvement. It helped, also, to evaluate the results of x-ray therapy on the extensions not directly visible by clinical examination.

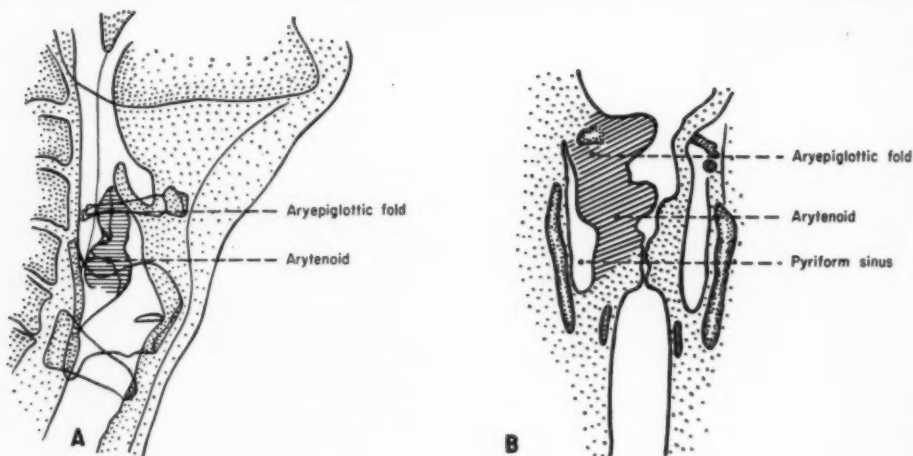


Fig. 22. Case J. J.

Clinical findings: Marked swelling of right arytenoid, aryepiglottic fold, obliteration of the pyriform sinus with visible tumor on the border of the aryepiglottic fold, and diminished mobility of the right hemilarynx. *Biopsy:* Squamous-cell carcinoma, Grade III.

Clinical diagnosis: Pyriform sinus tumor.

A. Lateral soft-tissue roentgenogram showing a mass on the aryepiglottic fold and swelling of the arytenoid.

B. Tomogram showing a mass on the aryepiglottic fold but no obliteration of the bottom of the pyriform sinus.

X-ray findings suggest that one is dealing with a tumor of the upper aspect of the aryepiglottic fold and not a tumor originating in the bottom of the pyriform sinus. This has considerable practical significance, since the former lesions are radiocurable.

A tumor dose of 5,750 r given in forty-four days through three fields produced a clinical disappearance of the lesion.

See also C and D, opposite page.

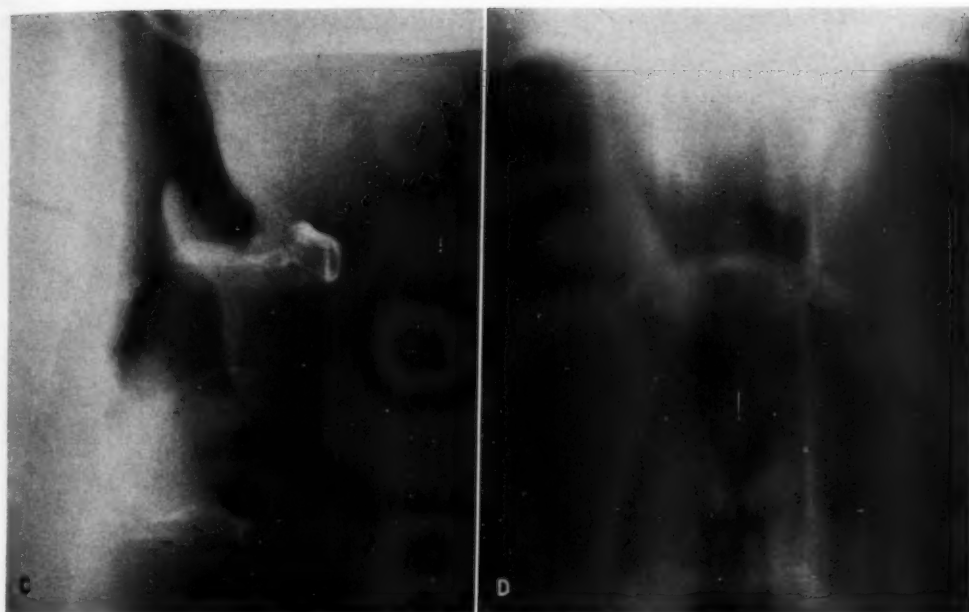


Fig. 22. Case J. J.

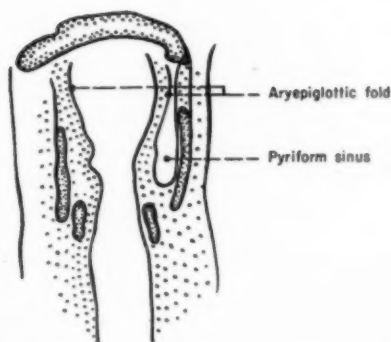
C and D. Follow-up a year and a half later shows no evidence of disease. Normal appearing larynx.

Comment: In this instance, the tomograms alone helped in differentiating between a tumor of the upper aspect of the aryepiglottic fold and the bottom of the pyriform sinus.



Fig. 23. Case V. T.

Clinical findings: Enormous nodes occupying the right parotid, submaxillary, and carotid areas. Nasopharynx



and oropharynx negative. Laryngoscopic examination was rather unsatisfactory. The only thing of interest observed was an apparent obliteration of the right pyriform fossa. *Punch biopsy of the nodes:* Metastatic carcinoma, Grade III.

Tomogram showing obliteration of the pyriform sinus, obviously due to compression, as the whole right hemi larynx is narrower than normal instead of being enlarged.

Comment: Tomograms helped rule out the presence of a primary pyriform sinus tumor.

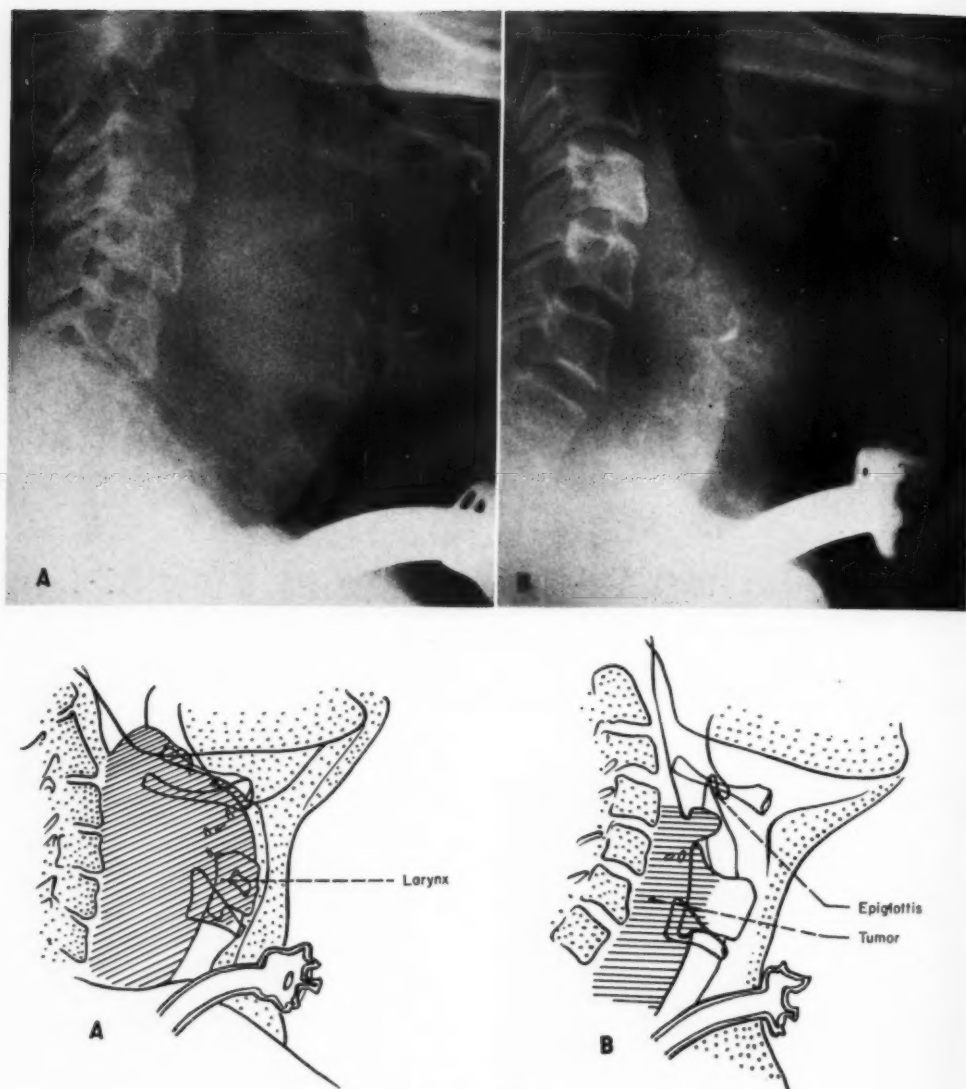


Fig. 24. Case J. O.

Clinical findings: There was considerable asymmetrical enlargement of the neck. On the left was a large, firm, smooth mass measuring approximately $6 \times 6 \times 8$ cm., compatible with an enlarged lobe of the thyroid. On the right a similar mass was present but somewhat smaller.

Examination of the pharynx was difficult and showed an irregular exophytic mass slightly to the left of the midline and practically completely replacing the epiglottis. The mass was covered by grayish necrotic exudate. **Biopsy:** Very undifferentiated tumor; no definite origin could be ascertained.

A. Lateral soft-tissue roentgenogram showing enormous prevertebral mass occupying the entire length of the neck and displacing anteriorly the trachea, the larynx, and the epiglottis. The upper aspect of the mass bulges at the level of the oropharynx.

B. After a relatively small tumor dose, the tumor shrank appreciably, but the patient died before completion of treatment. Lateral soft tissues at this time showed marked regression of the lesion.

Autopsy showed two types of thyroid tumor: papillary carcinoma and a giant- and spindle-cell carcinoma of the right lobe of the thyroid gland. Anatomically the tumor extended to the right pyriform sinus and all along the prevertebral tissues.

Comment: The lateral soft-tissue films determined the extent of the prevertebral involvement and permitted evaluation of the effect of therapy.

tumors of the bottom of the pyriform sinus and tumors of the upper level of the aryepiglottic fold (Fig. 22).

It is a common occurrence for tumors of the head and neck to manifest themselves by lymph node involvement, and the search for a primary site is often difficult or even unsuccessful. The two most frequent sites are the nasopharynx and pyriform sinus. The radiological examination can be of help in ruling out a tumor which might have been suspected clinically at those sites (Fig. 23). The method is also useful in miscellaneous locations. Occasionally, in tumors of the thyroid, complete extension of the disease is shown best by the roentgen examination (Fig. 24).

SUMMARY

A series of cases of tumors of the head and neck has been described in which the roentgenologic examination added information not obtainable by the usual clinical methods. The roentgen findings determined the site of the tumor, its degree and modes of extension, or its clinical variety. This information is of value in (1) deciding upon the treatment of choice (surgery or irradiation), (2) determining the

prognosis in either instance, (3) helping to plan the x-ray therapy or the surgical procedures, and (4) evaluating the results of treatment.

Note: Acknowledgment is made to the Medical Illustrations Department of M.D. Anderson Hospital for Cancer Research for drawings and photographs.

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SUMARIO

El Valor de la Técnica del Tejido Blando en el Diagnóstico de los Tumores de la Cabeza y del Cuello

Para el descubrimiento de los tumores de la nasofaringe, orofaringe, laringe e hipofaringe, porción cervical del esófago y tiroides, están indicadas radiografías laterales del tejido blando, complementadas con tomogramas y vistas especiales según se necesiten.

Preséntase una serie de casos, en forma de ilustraciones, en los que el examen roentgenológico aportó datos inobtenibles

con las habituales técnicas clínicas. Los hallazgos así obtenidos determinaron el asiento del tumor, la magnitud y modos de su difusión y su variedad clínica. Esta información resulta de valor para decidir el tratamiento de elección, es decir, cirugía o irradiación, para determinar el pronóstico; para planear la roentgenoterapia o el procedimiento operatorio; y para justipreciar los resultados de la terapéutica.

Pericardial Celomic Cysts¹

Presentation of Five New Cases and Five Similar Cases Illustrating Difficulty of Diagnosis

MAJ. JOHN C. BATES, MC, USA, and COL. FRANK Y. LEAVER, MC, USA

CHRONOLOGICALLY speaking, the first cysts which meet the requirements for a diagnosis of pericardial celomic cyst were reported by Dufour and Mourrut (1) in 1929 and by Pickhardt (2) in 1934. Impetus to further discussion and investigation was created by a report presented by Dr. Edward Churchill (3) in 1937, with a review of the pathology by Dr. Tracy Mallory. The patient was a 63-year-old Finnish laborer who complained of "stomach trouble" for fifteen years, with progression of symptoms. Laboratory and other data were essentially negative. X-ray films showed a mass located above the right auricle in the anterior portion of the chest. At operation a cyst was removed. This proved to have a thin wall of loose connective and fibrous tissue, which was relatively acellular, and a thin lining membrane thought to be mesothelium, though at points the cells could not be distinguished from endothelium. The lining cells occasionally, however, thickened up to a cuboidal type. The cyst contained clear fluid, and the designation "spring water" cyst has been attributed to Mallory, though the term is not mentioned in the original report.

In 1940, Lambert (4) presented a paper entitled "Etiology of Thin-Walled Thoracic Cysts," which adequately and logically explains the formation of these lesions. He reported 2 cases of thin-walled cysts located in the mediastinum and anteriorly in the chest, corresponding essentially to Mallory's pathologic description. Lambert first sought to establish these cysts as distinct entities. This he did by exclusion, stating that cysts of parasitic origin can be identified by their lining membrane; dermoids by their epidermal elements;

teratomas by the various compound elements of bone, cartilage, smooth muscle, mucous glands, and ciliated epithelium within their walls; the primitive alimentary tract cysts by smooth muscle fibers, mucous glands, and columnar epithelium. He further pointed out the necessity of differentiating between lymphangiomas and celomic cysts. A lymphangioma may have the histologic appearance of a pericardial celomic cyst, but it is composed of multiple cavities and is a conglomerate mass intimately incorporated with the structures in the area in which it occurs; it receives its blood supply from all sides and no cleavage line is found at operation. The pericardial cyst, on the other hand, is usually a single cavity having a sharp plane of demarcation; it does not receive its blood supply from all sides, and is easily removable.

Having thus established these thin-walled cysts as an entity, Lambert turned to the question of their origin. The pericardium arises from a series of disconnected lacunae which develop very early in embryonic life (can be seen in the "Gle" embryo of 1.54 mm.) (5). The pericardial celom arises by fusion of these lacunae. It is known that various congenital abnormalities of the pericardium can occur: it may be completely absent; it may communicate with other celomic cavities; or, as a result of inequality of development of the primitive lacunae, a pericardial diverticulum may be formed. Lambert suggested that cyst formation may result from failure of one of the primitive pericardial lacunae to fuse, with subsequent formation of a thin-walled cavity, for which the designation pericardial celomic cyst is appropriate.

¹ From the Department of Radiology, Fitzsimons General Hospital, Denver, Colo. Accepted for publication in February 1951.

A portion of this paper and films were presented as a scientific exhibit, Eleventh Midsummer Radiological Conference of the Rocky Mountain Radiological Society, Denver, Colo., Aug. 18-20, 1949.

In 1941 Blades mentioned pericardial celomic cysts in a paper on intrathoracic tumors (6), agreeing with Lambert as to the mode of origin. Greenfield *et al.* in 1943 (7) reported a single case having all the characteristics of a pericardial celomic cyst, but which they preferred to call a "spring-water" cyst.

As of 1947 there were only 7 reported cases which met the requirements of a pericardial celomic cyst, as defined by Bradford, Mahon, and Grow (8) at that time. These authors added 8 cases, using the following criteria for diagnosis: "(1) a thin-walled cyst; (2) clear fluid; (3) lining of endothelium or mesothelium that may look quite like epithelium." They believed that more of these cysts would be reported when the confusion regarding terminology and classification was settled. At almost the same time Lam published an excellent paper presenting a single case of pericardial celomic cyst (9). Five more examples were reported in 1948 by Cooper *et al.* (10), who also discussed the difficulty of differential diagnosis, with particular reference to fat pads as well as other tumors, which may occur in the chest.

Lillie, McDonald, and Clagett (11) in 1950 reviewed both the foreign and American literature and added 4 new cases of pericardial celomic cyst. They found 37 cases which satisfied the requirements for this diagnosis. At least one case, however, was not included in this total (9).

The following 5 cases fulfill the requirements originally defined by Mallory and re-emphasized by Bradford, Mahon, and Grow.

CASE REPORTS

CASE I (Fig. 1): A 49-year-old white female, well developed and well nourished, was found on routine examination, in Germany, to have a mass in the chest. She had been entirely asymptomatic and had no complaints. She was returned to the United States and was admitted to Fitzsimons General Hospital Aug. 21, 1948. At that time she complained of a sense of heaviness in the chest, dyspnea on exertion, and easy fatigability. Studies revealed a round smooth mass in the right cardio-

phrenic angle, lying well anterior in the chest. Fluoroscopy showed no pulsations, and the lesion was not thought to be associated with the diaphragm. Gastro-intestinal examination, including esophageal studies, was negative. Bronchograms suggested that the mass was extrapneumonic. Laboratory data were non-contributory.

At thoracotomy a large cyst was found, which was easily removed. Pathologically the cyst showed a tendency to be multilocular; it had a thin wall of connective tissue lined with a single layer of cells, and contained clear fluid. *Diagnosis:* Pericardial celomic cyst.

CASE II² (Fig. 3): A 33-year-old white female entered Gorgas Hospital in May 1949 because of a mass in the right cardiophrenic gutter discovered on a pre-employment film. She presented no symptoms on admission and only slight symptoms after being told that she had a lesion in her chest, which she admitted was probably due to the fact that she knew the x-ray findings were positive. Results of physical examination and routine laboratory tests were within normal limits. The patient's father had died of a "lung cancer" at the age of sixty-three years.

Bronchoscopic examination was essentially negative. Bronchograms revealed an extrinsic pulmonary lesion located in the right cardiophrenic gutter, close to the cardiac shadow, in the anterior chest. Serial x-ray studies showed no change in the lesion. Sputum studies were repeatedly negative.

No thoracic surgery was being done at the hospital at this time, and the patient was advised to return to the United States for definitive treatment or, if this could not be done, to report for monthly x-ray examinations. Bronchography in March 1950 showed the condition to be essentially unchanged. The patient had no complaints and all laboratory studies were within normal limits.

Thoracotomy was performed on March 28, 1950, at Gorgas Hospital, revealing what was thought to be a pericardial cyst located in the right pericardial phrenic gutter and measuring 8 × 8 × 5 cm. It was connected with the pericardial sac by a pedicle. This was incised and the cyst was removed. It measured 5 cm. in diameter, had a smooth, thin wall, and contained clear fluid. Microscopic section showed the cyst wall to be made up of collagenous tissue with a lining consisting of a single layer of flattened thick mesothelial cells. A few lymphocytes were present in the wall. *Diagnosis:* Pericardial celomic cyst.

CASE III (Fig. 5): A 20-year-old white male, a sergeant in the Air Force, gave a history of a nasal discharge, a productive cough, sore throat, and fever, developing about two and a half months before hospital admission and gradually and spon-

² From Gorgas Hospital, Ancon, Canal Zone.

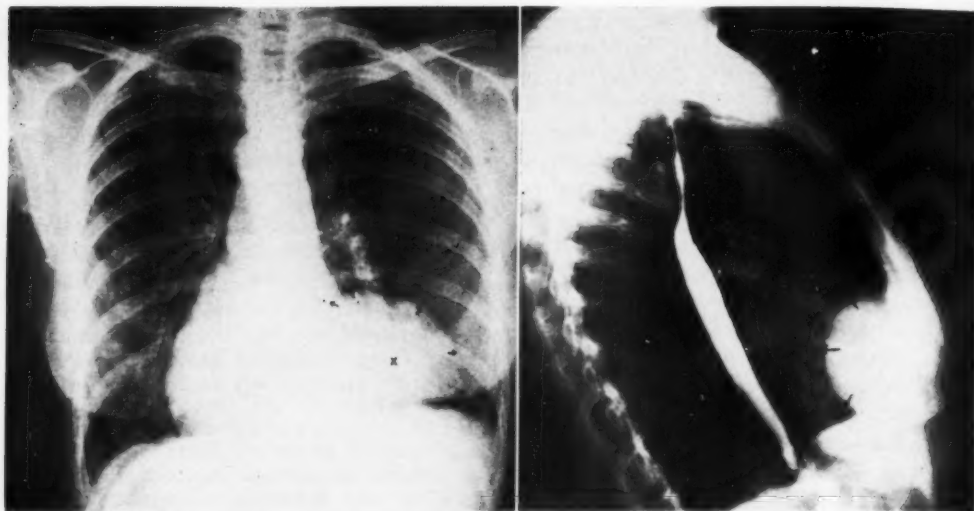


Fig. 1. Case I: Pericardial celomic cyst. Postero-anterior view showing a large mass in the cardiophrenic gutter. Lateral view showing anterior location of the mass on the right.

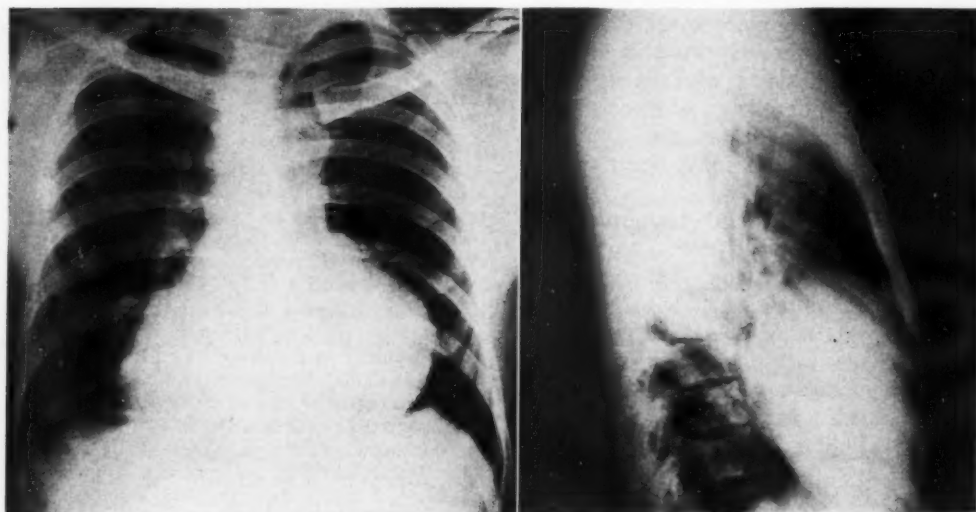


Fig. 2. Case A: Intrathoracic dermoid cyst. Postero-anterior view showing mass in right cardiophrenic angle. Lateral view showing the mass to be situated well anteriorly.

taneously disappearing. Approximately five days after subsidence of his symptoms the patient brought up an unknown quantity of rusty sputum and at the same time experienced substernal chest pain. X-ray examination at this time revealed a mass in the anterior right cardiophrenic sulcus, and the patient was transferred from AAF Station Hospital in Tucson, Arizona, to Fitzsimons General Hospital.

At Fitzsimons Hospital the former chest findings were confirmed. Bronchoscopy was reported as negative. Diagnostic pneumothorax on Sept. 2, 1950, suggested the possibility of a loculated effusion in the major fissure. A barium swallow revealed no evidence of intrinsic or extrinsic disease.

Thoracotomy was performed in September 1950 and a cystic mass 4 cm. in diameter was removed. Attached to one end was a large amount of adipose

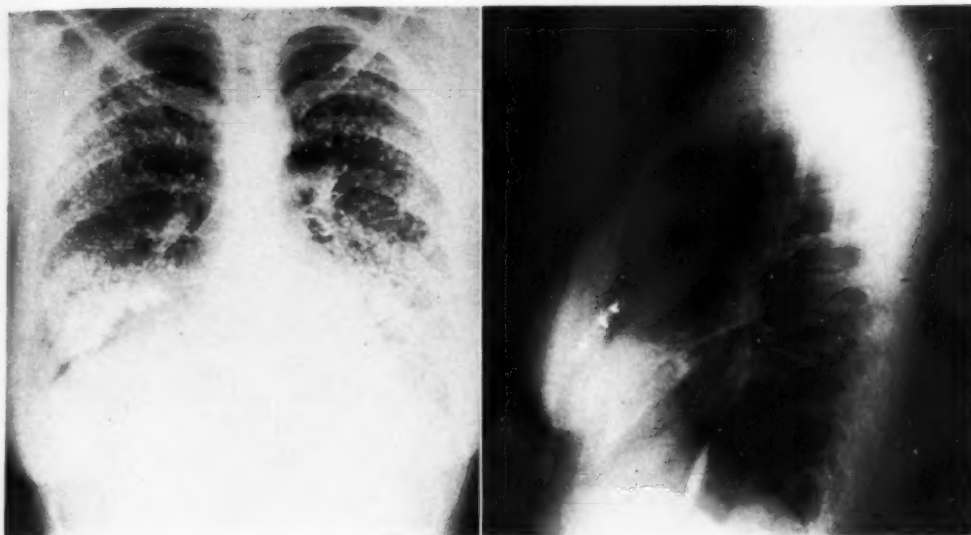


Fig. 3. Case II: Pericardial celomic cyst. Postero-anterior bronchogram showing a mass in the right cardiophrenic angle, with compression and displacement of the bronchi. Lateral view showing anterior location of the mass and some residual lipiodol in the bronchi.

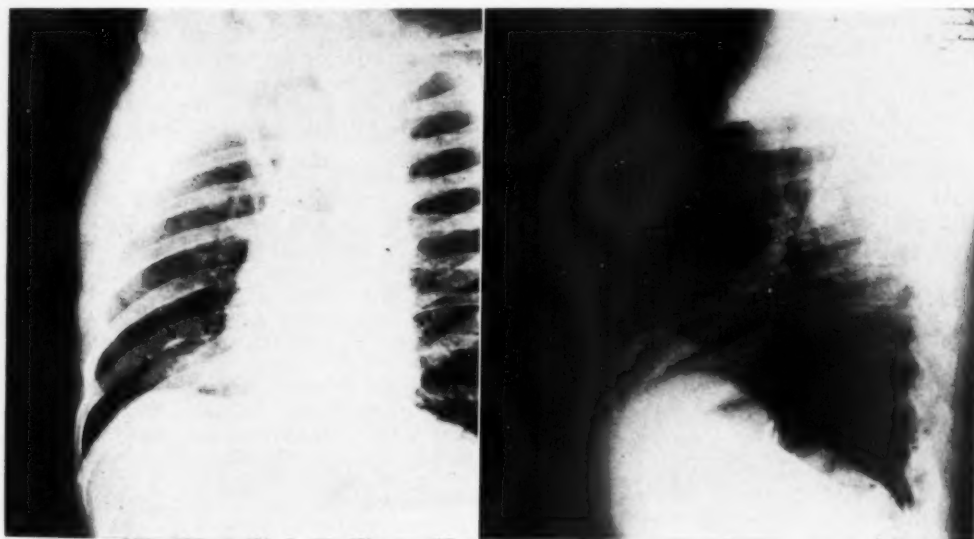


Fig. 4. Case B: Intrathoracic lipoma. Oblique film showing area of increased density in the right cardiophrenic angle. Lateral view showing anterior location of the mass.

tissue. The cyst walls were thin and the lining glistening. The cyst was filled with a clear yellow material. Microscopically the lining was seen to consist of a single layer of flat cells having rather large nuclei and slightly basophilic cytoplasm. This lining was surrounded by a few strands of fibrous connective tissue. There were no signs of

inflammation or malignant change. *Diagnosis:* Pericardial celomic cyst.

CASE IV (Figs. 7 and 8): A 24-year-old white male had episodes of sudden rapid pounding of the heart, followed by marked shortness of breath. The attacks occurred once or twice a month, over

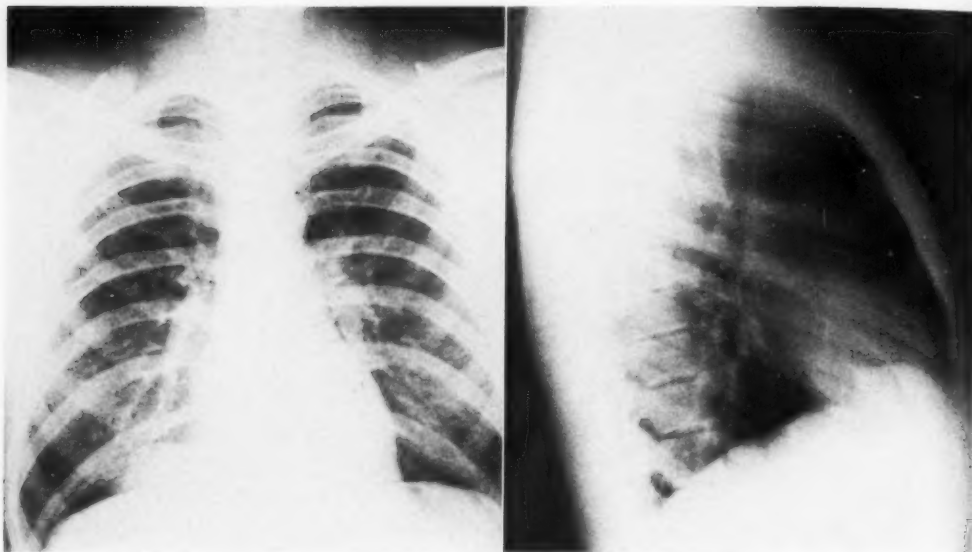


Fig. 5. Case III: Pericardial celomic cyst. Postero-anterior view showing a lesion in the right cardiophrenic angle. Lateral view locating the lesion anteriorly in the chest.



Fig. 6. Case C. Spindle-cell endothelioma of pleural origin. Postero-anterior view showing a mass in the right cardiophrenic angle.

a period of a year, and lasted about half an hour on each occasion. Twice the patient "blacked-out" for five or ten minutes. The most recent episode had occurred on March 1, 1950; the symptoms persisted, and the patient was admitted to William Beaumont Hospital. A chest film revealed a mass in the left anterior cardiophrenic sulcus. The blood pressure was 86/80; pulse 200. An electrocardiogram on admission showed paroxysmal auricular tachycardia, with a rate of 180 per minute. No

pulsation in the area of the mass was demonstrable fluoroscopically. The left leaf of the diaphragm appeared to be normal. Barium study of the upper gastro-intestinal tract revealed a normal esophagus, stomach, and duodenum. The patient was transferred to Fitzsimons General Hospital on March 22, 1950.

Thoracotomy was done in April 1950, revealing a cystic structure measuring $9.5 \times 7.5 \times 5.5$ cm., and weighing, with contents, 105 gm. The wall was paper-thin and transparent, with narrow white bands running through it.

The cyst contained 125 c.c. of crystal-clear, watery fluid (specific gravity 1.014) containing 34 mg. per cent total nitrogen and 15 mg. per cent sodium chloride. After evacuation of the fluid, the specimen weighed 25 gm. Microscopically the structure was extremely simple. There was a loose, fibro-fatty wall carrying vessels and occasional sinuses, with a few lymphocytes scattered through it. The lining consisted of a layer of low cuboidal or flattened cells with dark-staining, oval or round nuclei; these were apparently mesothelial cells similar to the lining of the pericardium. *Diagnosis:* Pericardial celomic cyst.

CASE V (Figs. 10 and 11): A 43-year-old white female was found, on routine chest examination in September 1949, to have a shadow in the right cardiophrenic sulcus located anteriorly. Chest films obtained one year earlier had been reported as negative. Barium studies of the gastro-intestinal tract were normal. Bronchoscopy was done and reported as negative. Repeated x-ray examination

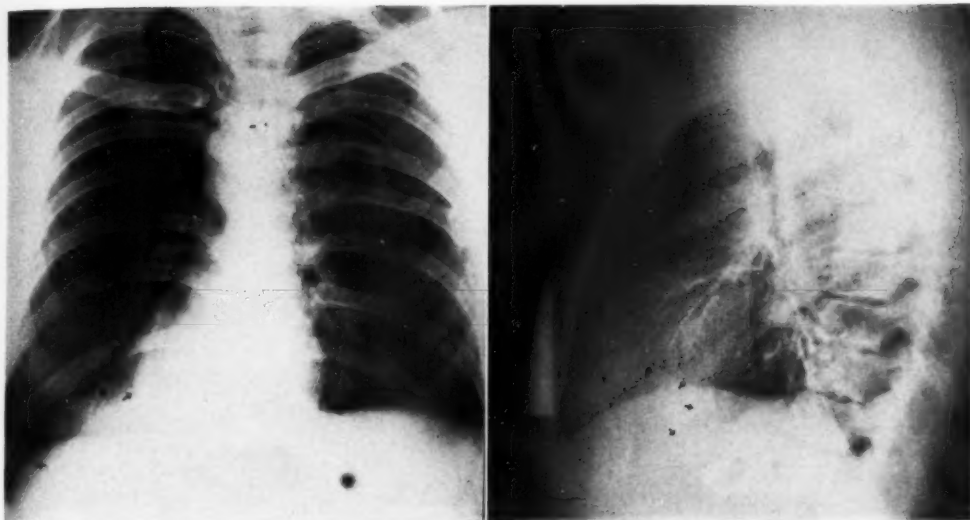


Fig. 7. Case IV: Pericardial celomic cyst. Postero-anterior view showing a lesion in the left cardiophrenic gutter. Lateral film showing lesion to be situated well anteriorly.

of the chest showed no change in the size or density of the lesion.

Thoracotomy was done in July 1950 and a mass was removed. It proved to be an oval, tense, translucent, unilocular cyst, weighing 140 gm. and measuring $9.0 \times 5.5 \times 5.5$ cm. One could almost read through the cyst. The contents consisted of 120 c.c. of crystal-clear fluid under marked tension (specific gravity 1.008, protein 0.5 mg. per cent, chlorides 30 mg. per cent, sugar less than 5 mg. per cent). The lining of the cyst was smooth and glistening. The wall was paper-thin and transparent. After removal of the fluid, the weight of the specimen was 12 gm. Microscopically the wall was found to be composed of acellular fibrous lamellae; the lining was made up of a single layer of low cuboidal cells of mesothelial type. *Diagnosis:* Pericardial celomic cyst.

In the 5 cases reported here and in those of Bradford, Mahon and Grow, the cysts were located in either the right or left costophrenic sulcus, though this has not been true of all cases presented in the literature. All, however, have been located anteriorly, whatever the anatomic position otherwise. Because of this fact, pericardial celomic cyst must be included in the differential diagnosis of anteriorly located masses in the chest, particularly if the lesion is in either cardiophrenic sulcus.

If the diagnosis of pericardial celomic

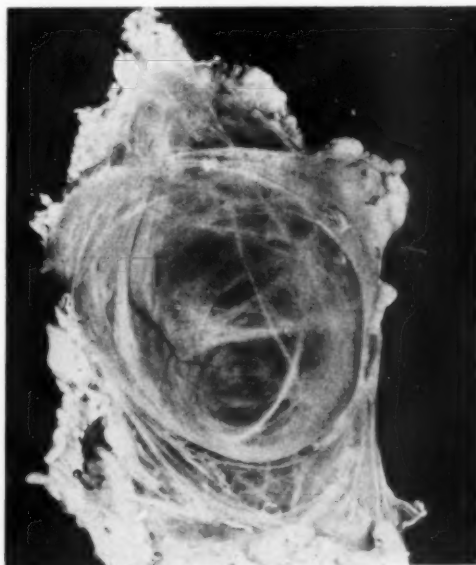


Fig. 8. Case IV. Pericardial celomic cyst after removal. Note thin walls.

cyst could be established roentgenologically or by other means, operation might not be necessary, as these tumors are relatively benign. An accurate diagnosis cannot be made, however, and any lesion which is located anteriorly in the chest may present the picture of a pericardial

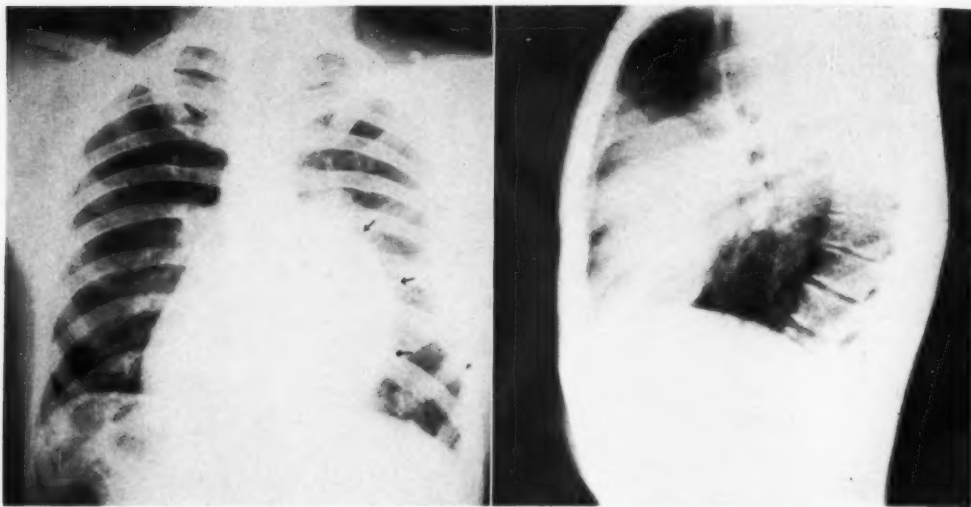


Fig. 9. Case D: Large hematoma, associated with an intrathoracic tumor. Postero-anterior view showing huge mass obscuring right cardiac border. Lateral view showing mass to be located anteriorly in the chest.

celomiccyst. The following cases and accompanying films corroborate this statement.

CASE A (Fig. 2): A routine film of the chest revealed a large mass in the region of the right costophrenic sulcus and right border of the heart, located anteriorly. At surgery a large cyst was found which was removed with moderate difficulty. *Pathological diagnosis:* Dermoid cyst.

CASE B (Fig. 4): A 30-year-old patient was found, on roentgen examination of the chest, to have a mass in the right costophrenic angle, located anteriorly. History, physical examination, laboratory and other studies were negative. At operation a lipoma was found in the right cardiophrenic angle.

CASE C (Fig. 6): A 38-year-old white male was found, on routine examination, to have a mass in

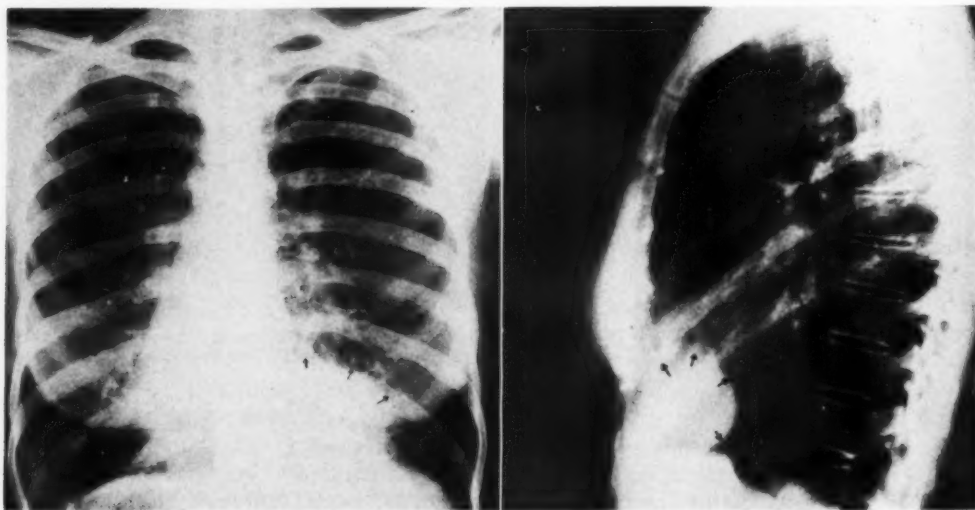


Fig. 10. Case V: Pericardial celomic cyst. Postero-anterior view showing mass in right cardiophrenic angle. Lateral view demonstrating anterior location of mass.

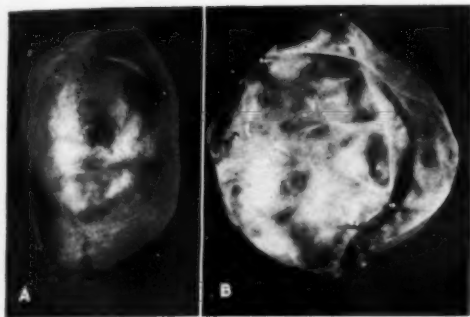


Fig. 11. Case V. A. Specimen after removal, still under tension. B. Specimen after opening. Note the thin glistening wall.

the chest, in the region of the right costophrenic sulcus, slightly anterior. The patient was hospitalized in a station hospital and later transferred to Fitzsimons General Hospital. History, physical examination, and laboratory studies were essentially negative, but the mass was observed to increase in size. At operation, a right lower lobectomy had to be performed. *Pathological diagnosis:* Endothelioma, spindle-cell type, with mucinous degeneration and extensive coagulation necrosis, of pleural origin.

CASE D (Fig. 9): A 28-year-old patient was admitted to the hospital because of mild weight loss. The only positive finding was a mass, demonstrated roentgenologically, located anteriorly along the right border of the heart. At operation a huge hematoma was found, which was evacuated as

completely as possible. A biopsy was taken of what appeared to be a small amount of tumor tissue in the area. Pathologically two entities were considered: (1) papillary adenocarcinoma, original site undetermined (this was the favored diagnosis); (2) angioendothelial sarcoma.

CASE E (Fig. 12): A 30-year-old white male was admitted to the hospital because of occasional pleuritic pains in the left chest. Physical examination and laboratory studies were negative. Films of the chest revealed a mass in the left base anteriorly, contiguous with the diaphragm. No hiatus hernia was demonstrated. An anomaly of the diaphragm was suspected, but tumor could not be excluded. At operation an eventration of the left diaphragm was found.

These cases, while far from being a true representation of tumors which may be confused with a pericardial celomic cyst, were selected because of the similarity of the histories and location of the chest lesion to the cases of pericardial celomic cyst here presented. They demonstrate clearly the difficulties of diagnosis.

SUMMARY

Pericardial celomic cysts, as pointed out by earlier writers, constitute a definite entity, probably originating on the basis of a failure of fusion of one of the primitive pericardial lacunae. While the diagnosis

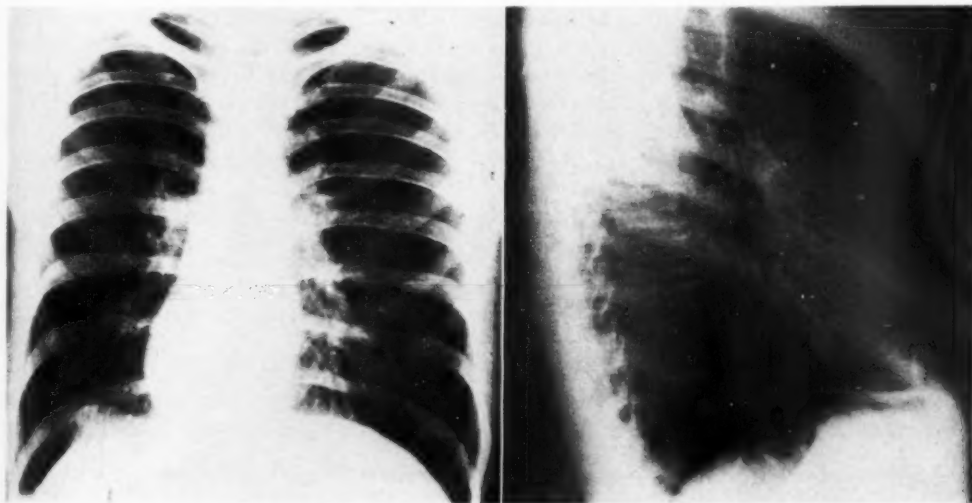


Fig. 12. Case E: Eventration of the diaphragm. Postero-anterior view showing a mass at the dome of the left diaphragm. Lateral view indicating anterior location.

cannot be definitely established roentgenologically, it must be taken into consideration in the presence of a mass located anteriorly in the chest, especially if it is in either costophrenic sulcus.

The literature is reviewed and 5 cases in which the diagnosis was proved at operation are added to those appearing in the literature, bringing the total to approximately 45. Five cases of other lesions are briefly presented because of the similarity of the histories and roentgen findings to those in the 5 patients with celomic cysts. The diagnoses in this second group were as follows: dermoid cyst; lipoma; spindle-cell endothelioma; probable papillary adenocarcinoma of undetermined origin; eventration of left diaphragm.

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SUMARIO

Quistes Celómicos del Pericardio. Presentación de Cinco Casos Nuevos y de Cinco Casos Semejantes para Demostrar las Dificultades del Diagnóstico

Los quistes celómicos del pericardio constituyen, según han señalado autores anteriores, una entidad bien definida, debiendo probablemente su origen a la falta de fusión de una de las primitivas lagunas pericardíacas. Si bien no puede establecerse el diagnóstico con precisión roentgenológicamente, hay que tomarlo en cuenta en presencia de una tumefacción situada en la porción anterior del tórax, sobre todo en uno u otro surco costofrénico.

Después de repasada la literatura, agré-

ganse, a los que aparecen en ésta, 5 casos en que se confirmó el diagnóstico en la operación, elevando así el total a unos 45. Debido a la semejanza de las historias y hallazgos roentgenológicos a los correspondientes a los 5 enfermos con quistes celómicos, preséntanse sucintamente 5 casos de otras lesiones. En el segundo grupo, los diagnósticos fueron: quiste dermoideo, lipoma, endotelioma fusocelular, probable adenocarcinoma papilar de origen indeterminado, eventración del diafragma izquierdo.

Roentgen Diagnosis of Intrathoracic Lymph-Node Metastases in Carcinoma of the Lung¹

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IT IS RECOGNIZED that in the combined surgical and radiologic attack upon cancer in any part of the body the cure rate will be influenced not only by the removal or destruction of the primary growth but by the absence or possible eradication of regional lymph-node metastases. When cancer develops in the lung, roentgenography is the only available method for preoperative determination of intrathoracic regional lymph-node involvement. It is therefore necessary that every effort be made toward the recognition of the presence or absence of such involvement at the time the primary tumor is discovered.

The size of a lymph node increases with invasion by carcinoma as well as with the infection which may accompany it. When a group of enlarged intrathoracic nodes is encountered, the two etiologic factors can be separated in only certain instances. (Enlarged nodes associated with laryngeal or phrenic nerve paralysis are almost always metastatic.) When carcinoma is suspected and when enlarged intrathoracic lymph nodes are demonstrable roentgenographically, metastases should be considered present until proved to be absent. Conversely, the absence of enlarged nodes does not exclude the presence of a small tumor embolus. Because this knowledge is important for a correct surgical attack upon the tumor, an attempt to recognize and describe the roentgen appearance of the intrathoracic lymph nodes has been made. The results of the study form the basis of this report.

For the purposes of the investigation, 221 cases of proved carcinoma of the lung treated surgically during the years 1942

through 1949 were reviewed. According to the surgeon's operative notes, 66 per cent (146 cases) showed enlargement of regional lymph nodes. In 11 of these cases the pathologist found no tumor in the submitted nodes; in 135 carcinoma was present. Further analysis was carried out in the latter group, plus 16 additional cases operated on in 1950. Of the total 151 cases, 48 were excluded, 3 because the tumor was multicentric, 34 because of inadequate data, and 11 because of insufficient surgical or pathologic information. Of necessity, the 103 cases finally selected were chosen on the grounds of the roentgen, surgical, and pathologic material at hand. Any case in which roentgenograms were unavailable or were technically inadequate was excluded, as were those in which the surgical exploration of the mediastinum was incomplete or was described with insufficient detail to allow estimation of the degree or localization of the lymph-node involvement.

In 53 of the group the primary tumor as well as the metastatic foci were removed and were studied histologically; in the remaining 50 the extent of the tumor precluded surgical removal. In the latter cases the surgeon noted the lymphatic involvement and at least one of the nodes was removed for microscopic examination. In the non-resectable cases it was necessary to depend on the surgeon's determination of the presence of lymph-node metastases by palpation, which even in the hands of the most skillful surgeon is not completely reliable, and on his statement of the anatomical site of the nodes.² Furthermore, the extent of the exploration in some in-

¹ From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10-15, 1950.

² In order to correct the deficiencies in the method of study, in recent cases biopsies from as many lymph nodes as possible have been obtained. If resection is impossible, a small silver clip is attached to each such node so that its location can be recorded on postoperative roentgenograms.

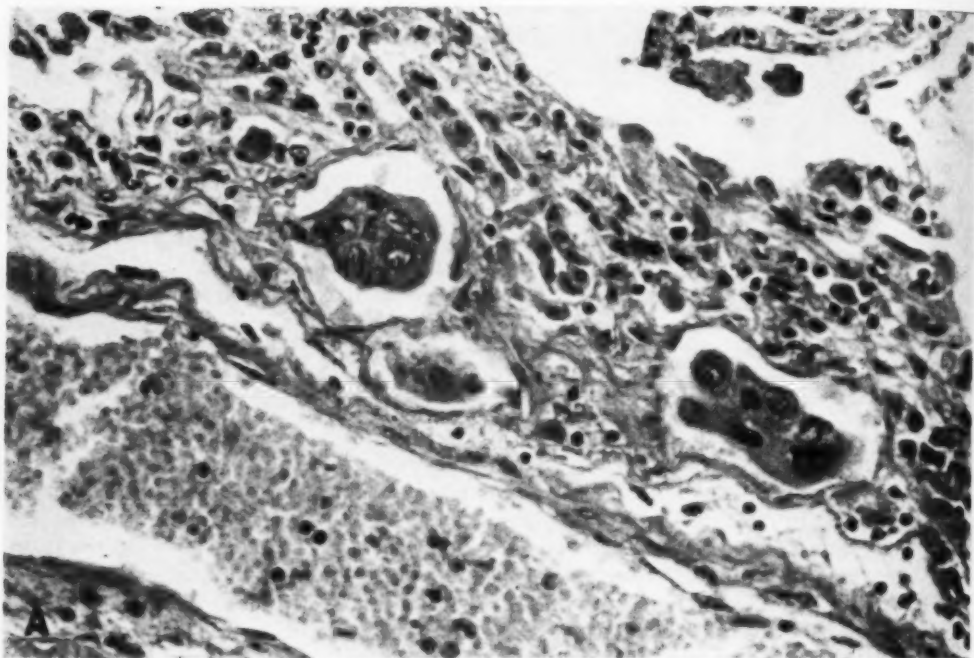


Fig. 1. A. Lymphatic channels in the lung. Perivascular lymphatic channels. (This is part of the deep lymphatic system which includes the peribronchial lymphatics and those of the interlobular septa.) In this section the thin-walled lymphatic capillaries are seen lying adjacent to the blood-vessel wall. Within the lymphatic capillaries are clusters of poorly differentiated malignant cells with hyperchromatic nuclei. These lymphatic capillaries follow the blood vessels toward the hilus, carrying lymph as well as tumor emboli to the lymph nodes of the hilus and mediastinum. Hemotoxylin and eosin. $\times 140$.

stances limited evaluation of certain suspected areas, particularly in the opposite side of the chest.

Although this group, therefore, represents an extremely selective sample, statistical analysis of which is impossible, it has afforded an opportunity for offering certain pertinent observations. These concern (1) the relative frequency of involvement of a given chain of lymph nodes in relation to the anatomic location of the primary tumor and (2) the fairly constant roentgenographic appearance of these lymph nodes when they are enlarged by tumor or associated infection.

ANATOMY AND PHYSIOLOGY OF THE PULMONARY LYMPHATIC SYSTEM

Lymph resembles the blood plasma in composition except that the protein content is lower, averaging from 0.5 to 0.7 gm.

per 100 c.c. At the capillary end of the arterial system fluid enters the tissues. Part of the fluid, together with protein and particulate matter, is returned to the circulatory system by way of the lymphatics. Conditions which will increase the flow of lymph are (a) increase in capillary pressure as a result of venous obstruction, (b) increased permeability of the capillary wall, and (c) increased functional activity of the part (1).

The smallest collecting vessel of the lymphatic system is the lymph capillary, a tubular structure with a thin wall formed by a single layer of flat endothelial cells. These capillaries empty into the larger lymphatic vessels, which have somewhat thicker walls and contain valves that control the flow of lymph.

Lymph nodes perform an important role in the work of the lymphatic system. Es-

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Fig. 1. B. Pleural lymphatic vessels. These vessels, which form the superficial lymphatic system, follow the visceral pleura over the lobes and along the interlobar septa. They are in anastomosis with the deep lymphatic system and, like it, transport lymph as well as tumor emboli to the intrathoracic lymph nodes. In this section the rich lymphatic capillary network is seen immediately beneath the visceral pleura. A single layer of endothelial cells lines these vessels, and the majority of them contain discrete clusters of malignant tumor cells. Hematoxylin and eosin. $\times 90$.

entially they are large collections of lymphocytes enmeshed in a network of reticulum and collagenous fibers. The whole is surrounded by a thin fibrous capsule. Lymph enters the subcapsular sinus of the node by several afferent lymphatic vessels and then passes through the medullary sinuses; it leaves the node by way of the efferent lymphatic vessel. The reticular fibers of the framework, which are generally believed to be formed by the fixed macrophages or primitive reticular cells, or both (14), penetrate all parts of the node. In its passage through the medullary sinuses, the lymph flows through these meshes. In this manner particulate matter or, more important, tumor emboli are filtered out, the latter to set up new centers of growth.

The lung is richly supplied with lymphatic capillaries and vessels. They are

grouped anatomically as the lymphatics of the bronchi, of the pulmonary arteries and veins, and of the pleura. There is also a chain of lymphatics in the interlobular septa. According to Miller (15), the bronchial lymphatics follow the branches of the bronchi only as far as the ductuli alveolares, and the alveolar walls contain no capillaries. The lymphatics of the bronchi, pulmonary artery and vein, and of the interlobular septa follow these structures toward the hilus, growing larger, receiving tributaries, and anastomosing freely. Collectively these groups are known as the deep lymphatic system (18) (Fig. 1 A). The lymphatics of the pleura also drain into the lung root and, as a group, are known as the superficial lymphatic system (Fig. 1 B). The careful anatomic studies of Miller have shown that there is free anastomosis between the two

systems and that both are equipped with valves which under normal circumstances allow the lymph to flow in one direction only, toward the hilus.

The lymphatics of the interior of the lung and of the pleural surfaces unite to form larger vessels which carry the lymph through the nodes of the lung root and on through those of the mediastinum on its way to deposition in the venous system. Knowledge of the route by which lymph passes from the lungs to venous channels is

growth of the lung around them, although their origin is outside the lung. On the right side the superior interlobar bronchial node lies in the angle between the right lower lobe bronchus and the intermediate bronchus. Adjacent to this anteriorly, at the bifurcation of the right upper lobe artery and the main trunk, is the superior interlobar arterial node. Variations are frequent, and either of these nodes may be absent or they may be fused into one node (Fig. 2). On the right side, also, there is

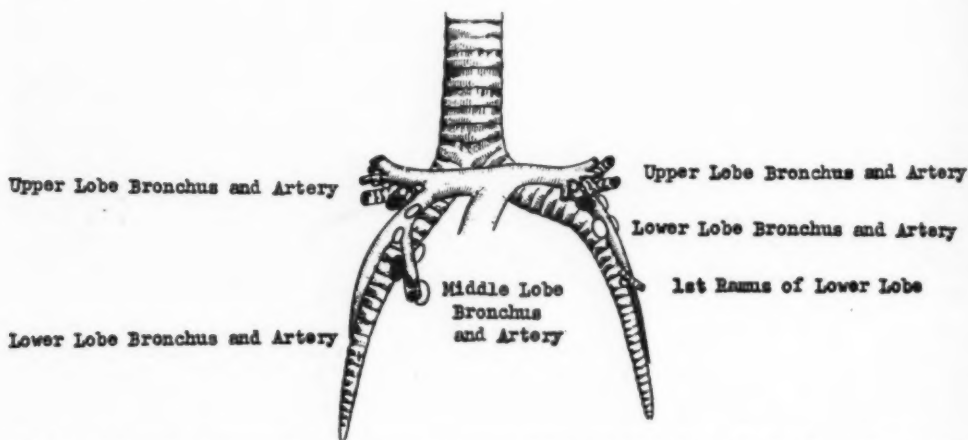


Fig. 2. Schematic representation of the intrapulmonary (lobar and interlobar) lymph nodes. The bronchial interlobar nodes are represented in black; the bronchoarterial nodes by dotted lines, while the other lobar and interlobar nodes are shown in relief. Figs. 2-5 are reproduced by permission of Rouvière (19).

based on the work of Rouvière (19), who during his investigations carried out detailed dissections on the bodies of over 200 newborn infants and young children. He has divided the visceral intrathoracic lymph nodes into four main groups: intrapulmonary, peritracheobronchial, posterior mediastinal, and anterior mediastinal or prevascular. Although anatomic variations are known to exist, it is the intent of this report to describe the most common localizations of the nodes.

The *intrapulmonary group* includes (a) the lobar nodes, of variable number and located at the bifurcation of the second and third order of bronchi and vessels, and (b) the interlobar bronchial and interlobar arterial lymph nodes. These nodes are classed as intrapulmonary because of the

present at the bifurcation of the right middle lobe bronchus the inferior interlobar bronchial node, which is in close association with an inferior interlobar arterial node. In the left lung, the interlobar bronchial node is at the bifurcation of the left upper and the left lower lobe bronchus. This is also accompanied by an interlobar arterial node, and the same variations exist as on the right side.

The *peritracheobronchial group* of nodes is composed of several subgroups in the following order. (a) The nodes of the pulmonary root lie in the area extending from the origin of the major bronchi to the mediastinal surface of the lung. These nodes are intimately related to the vein, artery, and bronchus, and are described as anterior, posterior, superior, and inferior.

(b) The nodes of the tracheal bifurcation, or the intertracheobronchial nodes, are disposed immediately below the bifurcation. They number three to five, the largest being to the right of the midline and extending downward along the inferior surface of the right main bronchus. (c) The retrotracheal node is usually a single node. (d) The paratracheal group is best considered as two separate chains. On the right side the chain parallels the trachea, lying posterior to the innominate vein and vena cava. The lowermost node lies adjacent to the azygos vein just above the junction with the vena cava, for which reason it is known as the node of the azygos vein. Superior to it and closely related to the trachea are three to five nodes of similar size. On the left side the paratracheal chain is smaller and the nodes are fewer in number. They are located alongside the trachea behind the aortic arch and left subclavian artery and lie in intimate association with the recurrent laryngeal nerve.

The *posterior mediastinal nodes* extend along the lower half of the esophagus and the descending aorta down to the diaphragm.

The *lymph nodes of the anterior mediastinum*, or the *prevascular nodes*, comprise two main chains, which may be considered separately. The chain on the left side is pre-arterial, beginning inferiorly with a node at the ligamentum arteriosum (the obliterated ductus Botalli). The node above this is located immediately in front of the aorta, and the chain continues anteriorly to the left carotid artery. The chain on the right side is pre-venous and passes upward anteriorly to the superior vena cava and the right innominate vein. Communicating vessels and occasionally lymph nodes are present in the anterior mediastinum between the right and left prevascular chain.

The lymphatic channels of the left paratracheal and the left anterior mediastinal chains join the thoracic duct to enter the venous system at or near the left jugulosubclavian juncture. In the corresponding chains on the right, the lymphatics form a large vessel which enters the venous system at or near the right jugulosubclavian juncture.

Extensive studies of the physiology of the lymphatic circulation in the lung have been made by Drinker (3). He found that particulate matter is carried from the lung directly in the lymph fluid and does not always undergo phagocytosis (4). His conclusion is based on the rapidity with which this process occurs. In experiments on dogs, Warren and Drinker (24) demonstrated that the greater portion of lymph from the lungs passes through the lymphatic vessels that follow the right paratracheal chain of nodes, while only a small amount leaves the left lung through the left paratracheal chain. This interesting observation confirms the anatomic findings in man made by Rouvière. According to the latter, the efferent vessels from the lower third of the left lung, as well as a portion of the vessels from its middle third, drain into the bifurcation lymph nodes and thence into the right paratracheal nodes. This chain receives in addition lymph from the entire right lung. These studies would suggest that the lymphatic drainage in man and dog are similar and that the greater portion of the lymph from both lungs passes through the right paratracheal channels. Warren and Drinker also found that the lymph flow was augmented with a low O_2 tension of the inspired air and also with increase of pressure in the pulmonary veins.

LYMPHATIC DISSEMINATION OF METASTASES FROM CARCINOMA OF LUNG

In an experimental study on dogs, Tuttle and Womack (23) injected carmine dye into the subpleural spaces in one group of animals and into the bronchial walls of the lower lobes in another group. When the animals were sacrificed, it was found that those which had received the dye in the subpleural areas had deeply stained intertracheobronchial lymph nodes, while those in which the dye had been injected into the bronchial walls exhibited only slight staining of these nodes. It was concluded from these experiments that pleural

lymphatics play the most important part in clearing the lung of particulate matter and that the lymphatic dissemination of carcinoma may be by the same system.

Metastatic tumor may reach regional lymph nodes from the primary focus by one of two methods: direct permeation along lymphatic channels or deposition of tumor emboli. While the former occurs occasionally, the latter is the more common mechanism (22). After invasion of lymphatic vessels, small clumps of tumor cells may become separated and be carried along by the lymph stream to the nearest lymph node, where they are entangled in the reticular network of the subcapsular or medullary sinuses. The node itself, with its constant flow of nutrient lymph, is a fertile field for further growth of the embolus. As Ewing (6) pointed out, the growth potentials of the cells are of chief importance in determining the fate of these emboli. Eventually, either by growth of the embolus or superimposition of further emboli, the node is completely replaced by growing tumor and undergoes progressive enlargement. Further emboli arise in the primarily involved node and pass to the second or third node in the same chain, or to a higher chain of nodes. As the node becomes filled with tumor and can no longer function as a filtering organ, the lymph flow is forced into other channels. Since it is unlikely that the valve system of the lymphatics can remain competent in the presence of blockage and dilatation, adjacent anastomotic channels take up the load. This results in lodgment of emboli in nodes outside the normal drainage pathway. For this reason, the lymph nodes which will become involved by carcinoma arising in any given anatomic unit cannot be predicated with certainty, no matter how thoroughly normal lymphatic pathways are understood. Lymph from the lower two-thirds of the left lung passes through the right paratracheal chain, but in the present study it could not be demonstrated that metastases from the lower two-thirds of the left lung showed any predilection for the right paratracheal lymph

nodes. This may be the result of blockage by the interposed nodes, which force the tumor-bearing lymph into other channels. The end-result of this process is widespread involvement of all the intrathoracic lymph nodes, with retrograde invasion of the cervical and retroperitoneal nodes.

There is little doubt that spread *via* the lymphatics is a most important method of dissemination of carcinoma of the lung. In a series of 36 autopsies reported by Lumsden (13), 31 or 86 per cent were found to have macroscopic deposits in the regional lymph nodes. In 3,047 cases collected from previous reports by Ochsner and DeBakey (16), 72.2 per cent had metastases in the regional lymph nodes. The chances of surgical cure of lung cancer are markedly affected by the presence or absence of these metastases. This is shown by a recent report (2) in which it was found that out of 29 patients with lung cancer and negative nodes, 10 or 34 per cent survived five years after surgery, while among those with positive nodes, there were no five-year survivals.

DISSEMINATION OF METASTASES IN GROUP PRESENTED

In the present investigation, attempts to evaluate the factors which influenced lymph node metastases were unsuccessful. To make such evaluation worth while, certain data should be available: (a) the time of appearance of the primary tumor and its age; (b) its histologic grade; and (c) its size. The first and probably the most necessary of these requirements is unobtainable. An estimated duration of symptoms is of little or no value in determining the age of the tumor, and few if any patients have had routine periodic roentgen examinations of the chest which might have dated the lesion to a certain extent. Accurate determination of the histologic grade is also difficult. It has been shown (17) that this varies in carcinoma of the lung with the site at which the microscopic section is taken. In the present series the carcinomas were classified as follows: squamous-cell 64, adenocarcinoma 7, oat-

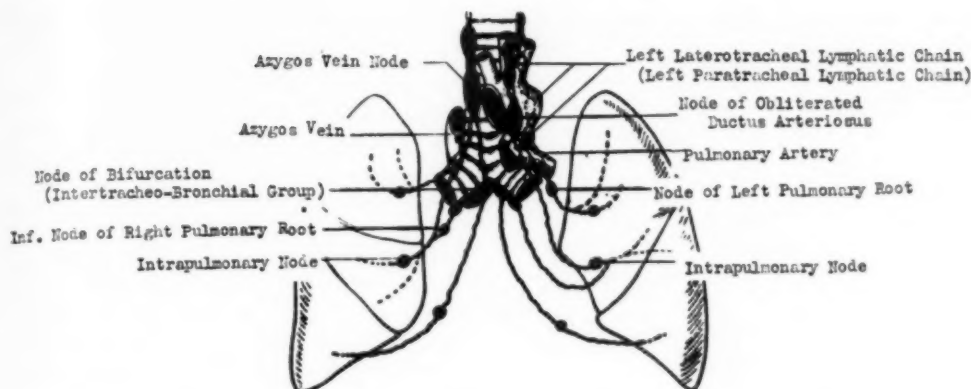


Fig. 3. Schematic representation of the pulmonary lymphatic regions. (After Rouvière.)

cell 8, undifferentiated 13; in 11 the biopsy was inadequate for classification.

LOCALIZATION OF PRIMARY TUMOR IN GROUP PRESENTED

In the entire group of 103 patients, all lobes and nearly all the segments of the lung were found to have been involved; the carcinoma originated in the right lung in 47 instances and in the left in 56. While it has not been possible to determine the exact anatomic origin of the tumors, their extent has been ascertained as nearly as possible. In lieu of a better method, they have been grouped arbitrarily according to the portion of the bronchial tree which had been invaded by the most proximal part of the growth. This grouping seemed as accurate as any, for when a tumor has reached a considerable size and is accompanied by hemorrhage, infection, or collapse, it is not possible, even by examination of the operative specimen, to discover the point of origin. On this basis the location of the primary tumor was as follows:

<i>Right</i>	
Main bronchus	3
Upper lobe bronchus	13
Anterior segment	6
Apical segment	2
Posterior segment	1
Intermediate bronchus	11
Middle lobe bronchus	2

Lower lobe bronchus	4
Superior segment	4
Anterior basal segment	1

<i>Left</i>	
Main bronchus	6
Upper lobe bronchus	17
Anterior segment	5
Apicoposterior segment	6
Lingular bronchus	4
Lower lobe bronchus	14
Superior segment	3
Posterior basal segment	1

LOCALIZATION OF LYMPH-NODE METASTASES ACCORDING TO LOCATION OF PRIMARY TUMOR

Although Rouvière's work did not divide lymph flow into lobar and segmental distributions, there seems to be a definite tendency in this direction. The present study does not indicate any particular *segmental* distribution but suggests a distinct pathway for *lobar* lesions which correspond roughly with the three zones of each lung described by Rouvière (Fig. 3). Variations in usual pathways may be explained on the basis of the two systems draining the lung and the extensive anastomoses between them. A third factor may lie in the fact that blockage of one lymphatic pathway may result in dissemination of tumor emboli outside the normal course.

In all of the present group of cases, the determination as to the localization of the mediastinal lymph node metastases was

made by surgical examination, and in most instances this was supplemented by microscopic confirmation. The localization of the intrapulmonary lymph-node metastases was determined from the roentgen examination and was confirmed histologically in those cases in which the lung was removed. In other words, the following analysis is a summation of the three methods of investigation. Where specific figures are given, the *intrapulmonary lymph nodes* were identified by roentgen observation, confirmed when possible by pathologic examination; the location of the *mediastinal nodes* is the result of surgical interpretation and could not always be verified on the roentgenograms or histologically.

Lymphatic Drainage of Right Lung
(Rouvière, Fig. 4)

Upper Lobe: The upper lobe has two lymphatic regions. From the *antero-medial region* the lymph may flow directly to the right paratracheal chain, particularly to the node of the azygos vein, or to the right prevascular chain; or it may be interrupted by the superior interlobar and the anterior or superior lung root nodes. From the *posterolateral region* the lymph may flow to either the right paratracheal chain or to the right bifurcation group of nodes, in the latter instance by way of the superior interlobar nodes.

Middle Lobe: Anatomically the lymph from this lobe drains to the right paratracheal chain and the right bifurcation nodes, either directly or *via* the superior or inferior interlobar nodes.

Lower Lobe: This lobe is divided into a superior and inferior region. From the *superior region* the lymphatic trunks run to the superior interlobar nodes and thence to the right paratracheal group. From the *inferior region* the lymph commonly drains to the nodes of the tracheal bifurcation. The collecting vessels adjacent to the lateral pulmonary ligament empty into the latero-esophageal nodes, and these latter, in their turn, empty into the bifurcation nodes.

Intrathoracic Lymph Node Involvement in Right Lung Carcinoma

In a patient with a tumor involving the *main bronchus* of the right lung, the lymphatic drainage might be expected to follow the pathways of all the lobes. Three patients fell into this category. In 2 there were metastases in the superior interlobar bronchial lymph nodes,³ and in 1 in the inferior node. The nodes of the pulmonary root were involved in all 3 cases, the right paratracheal chain (including the azygos node) in 2, the bifurcation in 1, and the posterior mediastinal in 1.

The primary tumor was localized to the *right upper lobe* in 22 cases. Here it was impossible to assign the tumors to precise regions as outlined above, because of the fact that the primary lesion was often far advanced and was found in and about major bronchi. Sixteen of the 22 patients had metastases in the superior interlobar lymph nodes, 14 in the nodes of the lung root, 11 in the right paratracheal chain (including the node of the azygos vein), 2 in the bifurcation nodes, and 3 in the right prevascular group.

Eleven tumors involved the *intermediate bronchus*. Among these, there was metastatic involvement of the superior interlobar nodes in 2, of the inferior interlobar nodes in 10, the pulmonary root nodes in 7, the bifurcation nodes in 6, the right prevascular in 1, the azygos vein node in 1, and the posterior mediastinal in 2.

In only 2 patients was the tumor localized strictly to the *right middle lobe* bronchus. In both cases the inferior interlobar and the pulmonary root nodes were invaded; in 1 the superior interlobar node was involved, in 1 the bifurcation node, and in 1 the posterior mediastinal node.

Nine tumors involved the *right lower lobe* bronchus, including 4 in the superior segment and 1 in the anterior basal segment. In 8 of the 9 there was metastasis to the in-

³ The lobar lymph nodes are not listed numerically because it is recognized that in many instances they are not palpated or could not be separated from the primary tumor, and unless the lung was removed accuracy was impossible.

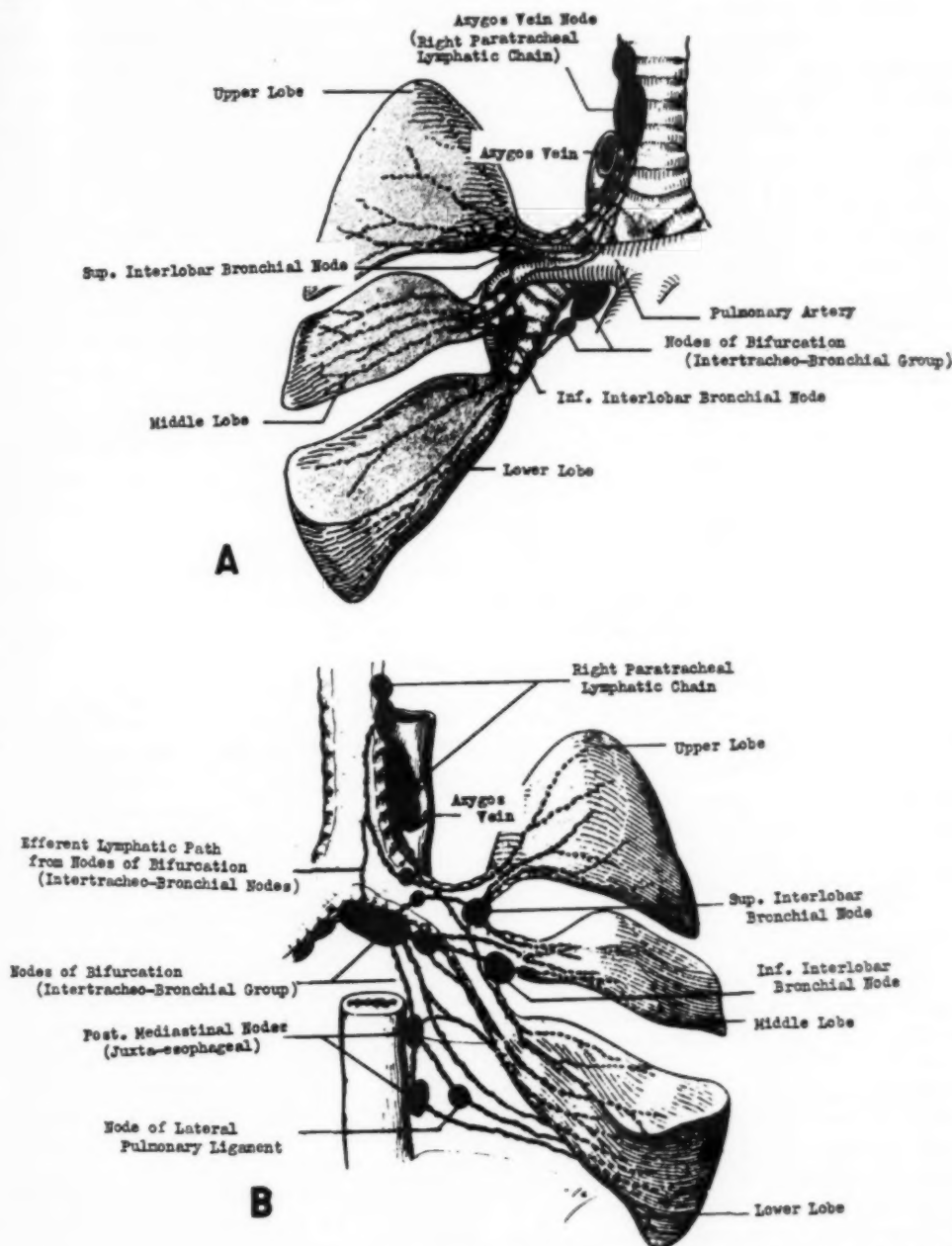


Fig. 4. Schematic representation of lymphatics of the right lung. A. Anterior view. B. Posterior view. (After Rouvière.)

ferior interlobar nodes; in 5 to the pulmonary root nodes; in 3 to the superior interlobar nodes; and in 5 to the bifurca-

tion nodes. The azygos vein node was involved in 1, and in 1 the left paratracheal group had also been invaded.

Lymphatic Drainage of Left Lung (Rouvière, Fig. 5)

Upper Lobe: The upper lobe is divided into two lymphatic regions, the superior and the inferior. The *superior region* empties by way of the nodes of the lung root into the left prevascular mediastinal chain and into the left paratracheal chain, both of which are in anastomosis by way of the subaortic vessel and node. The *inferior region* has essentially the same lymphatic drainage and, in addition, vessels pass to the nodes of the tracheal bifurcation either directly or by means of the interlobar node.

Lower Lobe: Three lymphatic regions are associated with the lower lobe of the left lung. (a) The *superior region* may drain either to the left prevascular chain and the left paratracheal or to the nodes of the bifurcation by way of the nodes of the lung root. (b) In the *middle region* the lymphatic vessels follow the same course as those of the superior region except they are often interrupted by the interlobar lymph nodes. These vessels, which pass to the bifurcation group, usually go through the subbronchial node. (c) In the *inferior region*, all the vessels pass to the bifurcation nodes. In the path of some of these vessels is a node of the lateral pulmonary ligament or a latero-esophageal node.

Intrathoracic Lymph Node Involvement *in Left Lung Carcinoma*

In 6 patients the primary tumor was in the left *main bronchus*. In 5 of these the interlobar nodes were involved, in 2 the pulmonary root nodes, in 2 the bifurcation nodes, and in 2 the left prevascular nodes.

The primary tumor was localized in the major and minor branches of the *left upper lobe bronchus* in 32 cases. In 16 of these there was metastasis to the interlobar nodes; in 22 the nodes of the pulmonary root were involved, mainly the superior and anterior; in 12 the left prevascular (7 in the node of the ductus Botalli); in 2 the left paratracheal; in 2 the bifurcation; in 1 the right prevascular, and in 2 the right paratracheal

nodes. Among those patients with left prevascular and left paratracheal lymph-node metastases, phrenic nerve paralysis was found in 4 and recurrent laryngeal paralysis in 6. The close relationship of the left recurrent laryngeal nerve and the mediastinal lymph nodes on the left side has been pointed out by Sukiennikow (21) and by Rouvière.

Of the 18 tumors which were localized in the *left lower lobe bronchus* and/or its subdivisions, metastases were found in the interlobar nodes in 12, in the pulmonary root nodes in 12, in the bifurcation group in 3, in the left prevascular chain (including the node of the ductus Botalli) in 4, in the left paratracheal in 2, in the right paratracheal group in 1, and in the retrotracheal node in 1.

ROENTGEN TECHNIC FOR DEMONSTRATION OF INTRATHORACIC NODES

Ideally the roentgenographic technic should be the simplest that will give the desired information. Although more intricate procedures may have value in better demonstrating obscure lymph nodes, they are best avoided if they are uneconomical or if they cause a delay in operative intervention. It has been concluded from the present investigation that intrathoracic lymph nodes, when sufficiently enlarged, can be demonstrated roentgenologically by simple methods. The demonstration, however, will be dependent upon proper equipment and meticulous technic.

The first step in the examination is fluoroscopy to study the dynamics of respiration. At the same time, a swallow of thin barium is given and a detailed examination of the outline of the esophagus is made. From fluoroscopy the decision is made as to the particular films which will be required to show the primary tumor as well as the possibly enlarged lymph nodes. As a routine, a minimum of three films are taken—a postero-anterior, a lateral, and an overexposed grid or Bucky postero-anterior. In a patient with apparent or suspected metastases, a more detailed examination may be required. The ordinary

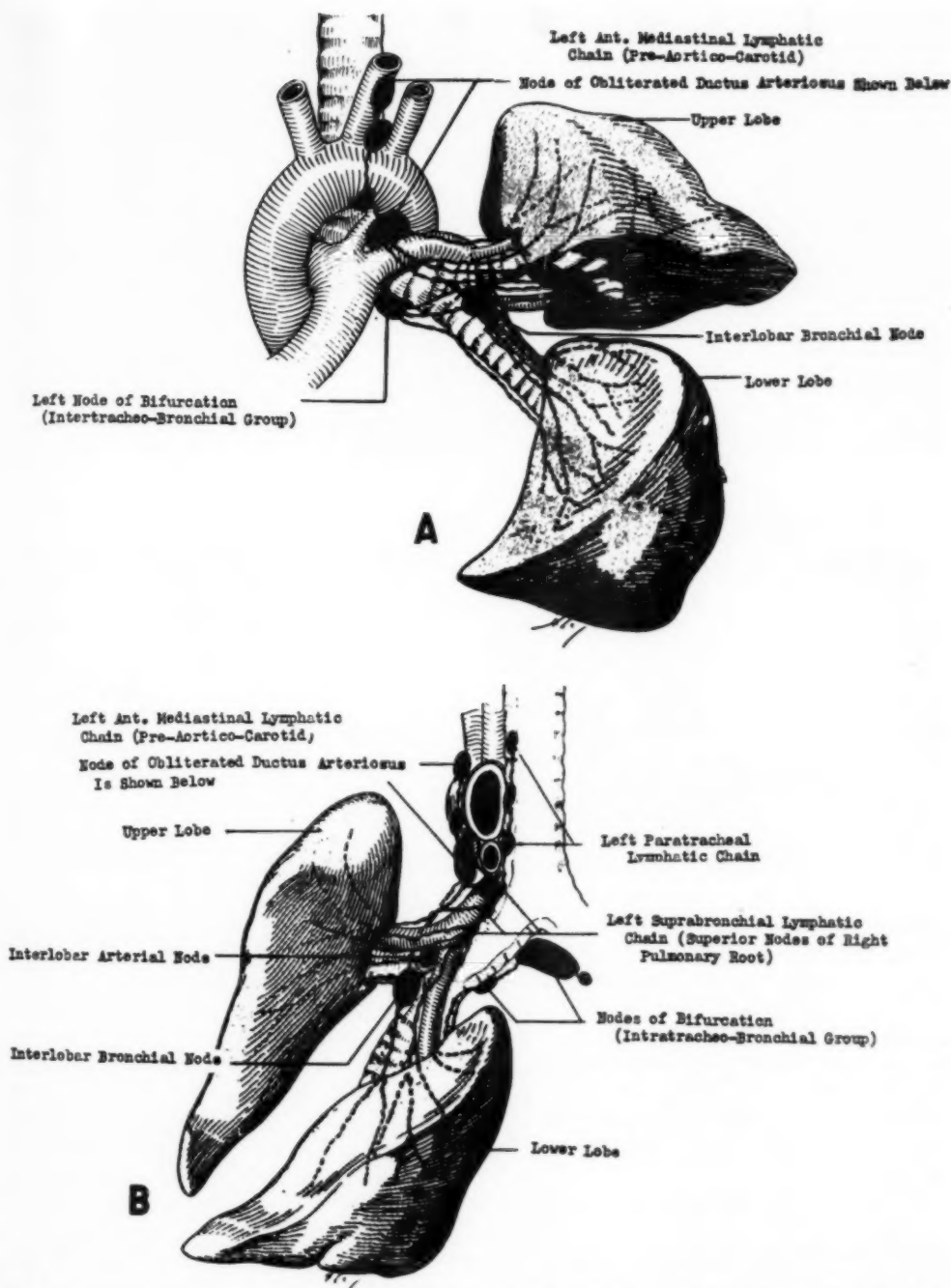


Fig. 5. Schematic representation of the lymphatics of the left lung. A. Anterior view. B. Posterior view. (After Rouvière.)

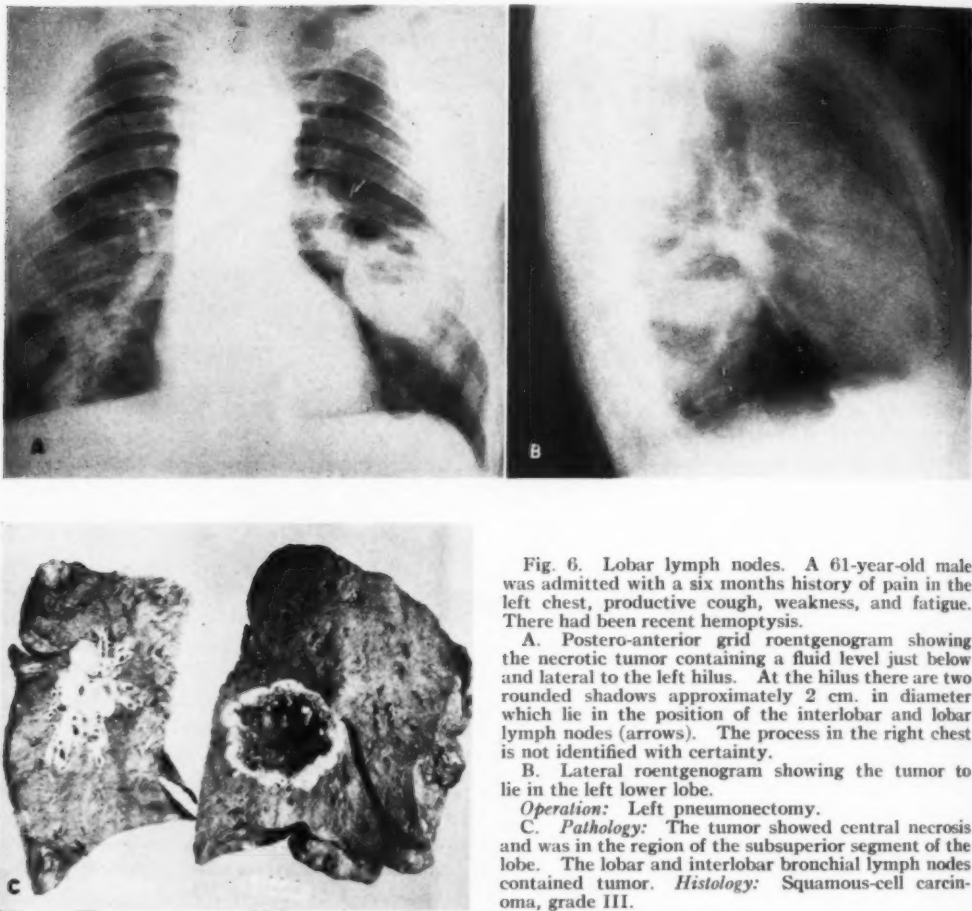


Fig. 6. Lobar lymph nodes. A 61-year-old male was admitted with a six months history of pain in the left chest, productive cough, weakness, and fatigue. There had been recent hemoptysis.

A. Postero-anterior grid roentgenogram showing the necrotic tumor containing a fluid level just below and lateral to the left hilus. At the hilus there are two rounded shadows approximately 2 cm. in diameter which lie in the position of the interlobar and lobar lymph nodes (arrows). The process in the right chest is not identified with certainty.

B. Lateral roentgenogram showing the tumor to lie in the left lower lobe.

Operation: Left pneumonectomy.

C. Pathology: The tumor showed central necrosis and was in the region of the subsuperior segment of the lobe. The lobar and interlobar bronchial lymph nodes contained tumor. Histology: Squamous-cell carcinoma, grade III.

postero-anterior film is most helpful in demonstrating enlargement of the lobar and interlobar lymph nodes (the intrapulmonary group) and the nodes of the pulmonary root, as in the majority of cases they are surrounded by aerated lung. The postero-anterior grid or Bucky film is of value for delineation of the paratracheal nodes, the prevascular, and the bifurcation groups.

Present trends indicate that high-kilovoltage (125 kv.) technic may allow a single film that will furnish the required information regarding both the intrapulmonary and the mediastinal nodes, but as yet this technic has not been adequately investigated to be of routine use. For

demonstrating the bifurcation group, as well as the latero-esophageal nodes of the posterior mediastinal chain, it is essential that the esophagus be outlined by barium. Over-distention, however, should be avoided, as this will tend to obscure the lymph nodes or minor changes in the outline of the esophagus. Additional oblique films, as well as spot films of the suspected areas, are taken as indicated by the fluoroscopic study.

Special technics may be of great help but should not be advocated merely for the sake of carrying out further roentgen procedures when the same information will be obtained by other routine methods such as bronchoscopy. Laminagraphy will re-

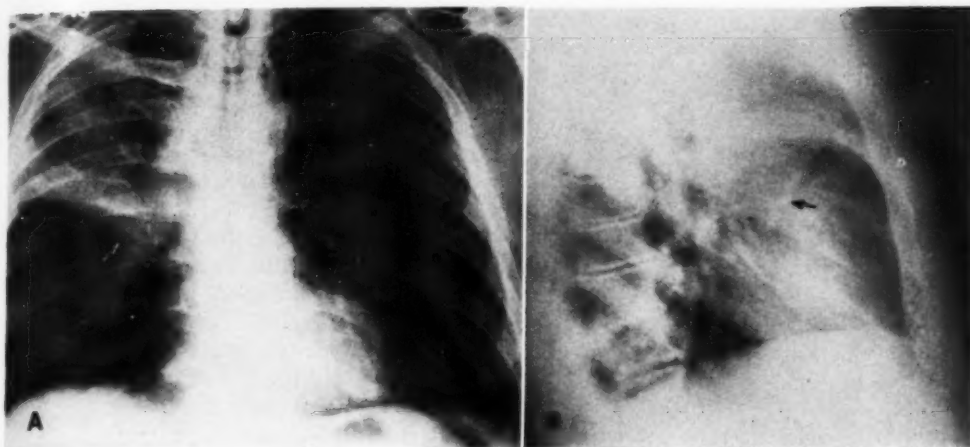


Fig. 7. Right interlobar and pulmonary root lymph nodes. A 64-year-old male gave a five weeks history of malaise, fever, and chest pain on deep breathing. Bronchoscopy showed the coryna to be widened and displaced posteriorly, with evidence of extrinsic pressure along the right main bronchus from its right lateral wall. No intraluminal tumor was seen.

A. Plain postero-anterior roentgenogram showing considerable density in the right upper lobe with downward displacement of the medial portion of the minor fissure indicative of enlargement of the right superior interlobar and lobar nodes, as well as the primary tumor (arrow).

B. Lateral roentgenogram showing the enlarged interlobar node (arrow), as well as the area of atelectasis in the anterior segment of the upper lobe.

Operation: The primary tumor appeared to arise from the upper lobe bronchus. Involvement of the interlobar and pulmonary root lymph nodes was evident. Resection was not possible because of the extensive metastases. *Histopathology:* Oat-cell carcinoma.

veal the lymph nodes more clearly, but it is an expensive and time-consuming procedure, and in the authors' experience it has given only slightly more information than Bucky or grid films. Transverse laminagraphy, recommended by continental radiologists (8), has not been thoroughly tried in this hospital. Experience with angiocardigraphy has been limited. Equipment for this is not generally available, and the procedure is not without risk to the patient; it is rarely necessary in the differential diagnosis of carcinoma of the lung. Iodized-oil bronchography will give an excellent visualization of the bronchial tree and will bring to light minor displacements caused by enlarging lymph nodes. Because of possible complications, however, this method should be used with discretion.

ROENTGENOGRAPHIC APPEARANCE OF INTRATHORACIC LYMPH NODES

In the "normal" chest most lymph nodes are not visible unless calcified or enlarged

as a result of infection. The normal nodes vary in size from several millimeters up to 1 cm. in diameter; they can rarely be distinguished on the roentgenograms from the vascular structures of the mediastinum and lung root. When the nodes become enlarged, visualization is made possible by three mechanisms (9): (a) the node may project into the normal lung, as a result of which there is a contrast between the air-filled lung and the soft-tissue density of the node; (b) there may be alteration of the normal contour of an anatomical structure; (c) there may be displacement of normal anatomic structures. It is for the last reason that the overexposed grid film is taken; it delineates the air-filled trachea and bronchial tree. For the same reason, the esophagus is outlined with barium.

The *lobar nodes*, which are intrapulmonary, more often than not can be seen when surrounded by aerated lung (Fig. 6). They are, however, frequently located close to the primary tumor and, if the lung is collapsed distal to the tumor, they cannot



Fig. 8. Right superior pulmonary root lymph node. A 62-year-old male entered with a nine months history of pain in the right chest and below the scapula. There had been recent hemoptysis. Bronchoscopy revealed no evidence of intrabronchial tumor.

The plain postero-anterior roentgenogram shows the tumor in the medial portion of the apical segment of the right upper lobe and enlargement of the superior root node (arrow) in the region of the right upper lobe primary bronchus. Above this, lying against the right main bronchus superiorly, is the enlarged azygos node.

Operation: The tumor was not resectable because of the extensive involvement of the lymph nodes, which were biopsied. *Histopathology:* Carcinoma.

be separated from it or the associated collapsed segment of the lobe. (Metastases to these nodes may account for the nodularity often seen along the margin of what is considered the primary tumor.)

The *interlobar bronchial and arterial nodes* take part in the lymphatic drainage of both lungs. (a) An enlarged right superior interlobar node is usually delineated clearly on the plain postero-anterior film of the chest. It must be differentiated by its size and shape from the interlobar branch of the right pulmonary artery, which lies anteriorly (Fig. 7). In the presence of collapse of the right upper lobe, this node casts a dense curved shadow against the emphysematous middle lobe with its convexity caudad, while the collapsed lobe above the minor fissure gives a curved shadow with its convexity cephalad. The merging of the two shadows results in an

S-curve originally described by Golden (10) and later by Sante (20). (b) The inferior interlobar lymph node on the right side lies slightly above and anterior to the right middle lobe orifice. It, too, is best seen on the plain postero-anterior film, or may be brought out by the oblique films. (c) On the left side the interlobar node lies between the branches of the left main bronchus. It also must be differentiated from the interlobar branch of the left pulmonary artery (see Fig. 6). In the presence of collapse of the left upper lobe, the density formed by the interlobar node and the collapsed lobe, as seen in the lateral film, likewise has an S-shaped appearance.

The *nodes of the pulmonary root* are intimately associated with the structures of the hilus, and for this reason their detection is most difficult. An overexposed grid film is necessary to show them adequately. Enlargement of the superior group is manifested by a nodular density above and superimposed upon the major branch of the pulmonary artery (Fig. 8). Enlargement of the inferior group will occasionally cause an indentation upon the inferior margin of the main bronchus (Fig. 9). Because of the density of the vascular structures, the anterior and posterior groups of pulmonary root lymph nodes have not been successfully demonstrated.

The *nodes of the right paratracheal chain* are perhaps the most easily demonstrated of those located in the mediastinum. The lowermost node of this group (the node of the azygos vein) lies within the angle formed by the trachea and the right main bronchus. When markedly enlarged, it often causes a slight indentation on the right lateral margin of the trachea (Fig. 10). The remainder of the right lateral tracheal chain of nodes lies above the azygos node. Ordinarily these nodes, if enlarged, are easily seen projecting into the air-filled medial margin of the right upper lobe (Fig. 11), or there may be associated distortion of the trachea. In the late stages the metastatic tumor may invade the tracheal wall. The right upper lobe, when collapsed, assumes a position

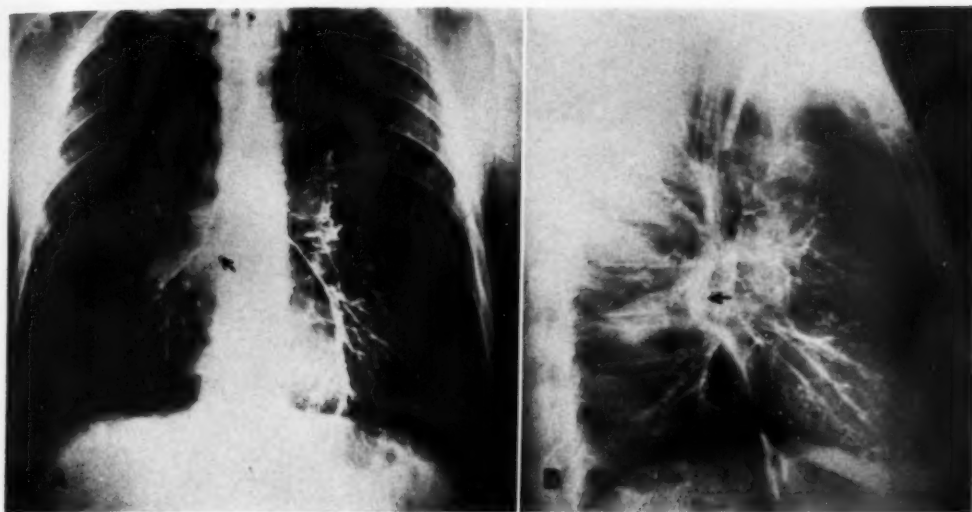


Fig. 9. Bifurcation and right inferior pulmonary root lymph nodes. A 47-year-old male entered with a history of wheeze and blood-streaked sputum of six months duration. Bronchoscopically, just below the right upper lobe orifice was seen a firm nodular lesion arising from the posterior wall of the right intermediate bronchus.

A. Postero-anterior grid bronchogram showing a shadow lateral to the intermediate bronchus, which is probably composed in part of the inferior interlobar node and in part of the collapsed superior segment of the right lower lobe. Medially to the bronchus there is a shadow of increased density representing the enlarged bifurcation nodes (arrow).

B. Lateral bronchogram showing, in addition to the collapse of the superior segment, marked displacement of the esophagus (arrow) due to enlarged bifurcation nodes.

Operation: Right pneumonectomy. Large lymph nodes were found in the subbronchial and bifurcation areas. The nodes were removed and found to contain tumor.

Pathology: The tumor partially occluded the right main bronchus, involving the lower portion of the right upper lobe and the apex of the lower lobe at the hilus of the lung. A lobulated mass of lymph nodes was present on the inferior aspect of the main bronchus, and several smaller nodes extended down this bronchus into the parenchyma of the lung and in close proximity to the main tumor mass. *Histology:* Squamous-cell carcinoma, grade III.

toward the midline in the anterosuperior portion of the chest. When this is the case, these nodes will be obscured by the collapsed lobe, and their identification will be impossible in the absence of tracheal indentation.

The *left paratracheal group of lymph nodes* is difficult to visualize, because this chain lies medially and posteriorly to the arch of the aorta and the left subclavian artery. In those cases where enlargement of these nodes has been found at operation, a nodular density has been seen superimposed on the trachea (Fig. 12). The mechanism by which this nodular density has been produced is not clear. Since this chain of nodes lies slightly posteriorly to the lateral margin of the trachea, they may, when enlarged, possibly indent the posterior wall of the air-filled trachea and thus become vis-

ible by their contrast. It has not been possible, however, to confirm this assumption by bronchoscopy. Another possibility is that the enlarged nodes impinge upon the medial margin of the right lung, which has been shown by Lachman (11) to extend close to the midline of the thorax in the retro-esophageal area. Further study is indicated in order to elucidate this problem.

The *bifurcation group of lymph nodes* is well hidden behind the heart and great vessels. Nevertheless, significant enlargement of these nodes may be detected with careful technic. It should be pointed out that their enlargement does not usually result in widening of the coryna, and this sign cannot be regarded as a reliable index of the presence or absence of enlargement. (Widening of the coryna may be caused by

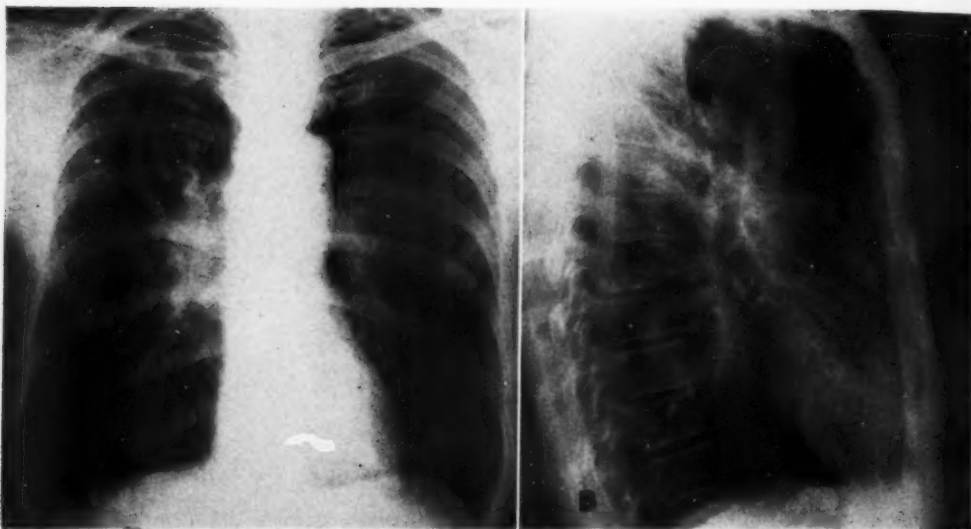


Fig. 10. Node of the azygos vein. A 58-year-old male entered because of a chronic cough which had persisted for seven months following a "cold." For three months he had suffered from malaise, nausea, and dyspnea, which had developed after the extraction of several teeth. There had been a 7-lb. weight loss. Bronchoscopically, a mass, 0.5 cm. in diameter, was seen originating from the lower border of the right upper lobe bronchus.

A. Plain postero-anterior roentgenogram showing evidence of enlargement of the azygos vein node (arrow) which lies adjacent to the right margin of the trachea just above the origin of the right main bronchus. Below this mass is a shadow consistent with enlargement of the superior pulmonary root node, and inferiorly to the latter shadow is a mass which is probably composed of primary tumor and the superior interlobar nodes.

B. Lateral roentgenogram showing the location of the primary tumor and the associated lymph nodes.

Operation: Right pneumonectomy. The node of the azygos vein was enlarged, and in addition a node was found in the prevascular area.

Pathology: The primary tumor involved the right upper lobe bronchus and invaded the parenchyma. The lymph nodes were involved by tumor. Histology: Squamous-cell carcinoma, grade IV.

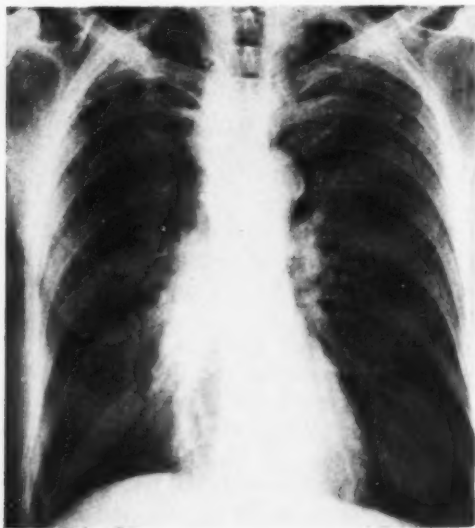


Fig. 11. Right paratracheal lymph nodes. A 54-year-old male gave a one year history of cough, wheeze, and weight loss, with recent hemoptysis, dyspnea,

collapse of either of the upper lobes; narrowing of the coryna may follow collapse of one or the other lower lobes.) When the largest node of this group, which lies to the right of the midline, increases in size, it may indent the medial margin of the right main bronchus (12) (Fig. 13). The bifurcation nodes may also cause a pressure defect on the adjacent esophagus (7). On the overexposed film, this defect can be

right chest pain, and malaise. Bronchoscopy revealed a narrowing of the lumen just beyond the right upper lobe orifice, by pearly gray tumor.

The postero-anterior grid roentgenogram shows indentation of the right side of the trachea above the aortic arch, due to enlarged paratracheal nodes. The obstructed right intermediate bronchus is seen, and medially to this is a shadow protruding into the mediastinum, consisting of enlarged bifurcation nodes.

Operation: Numerous lymph nodes around the hilus were demonstrated extending upward above the azygos vein. Below the coryna the tumor had extended beyond the capsule of one of the enlarged nodes and had invaded the wall of the esophagus. (This was not disclosed by roentgen examination because barium had not been introduced.) Histopathology: Squamous-cell carcinoma, grade II.

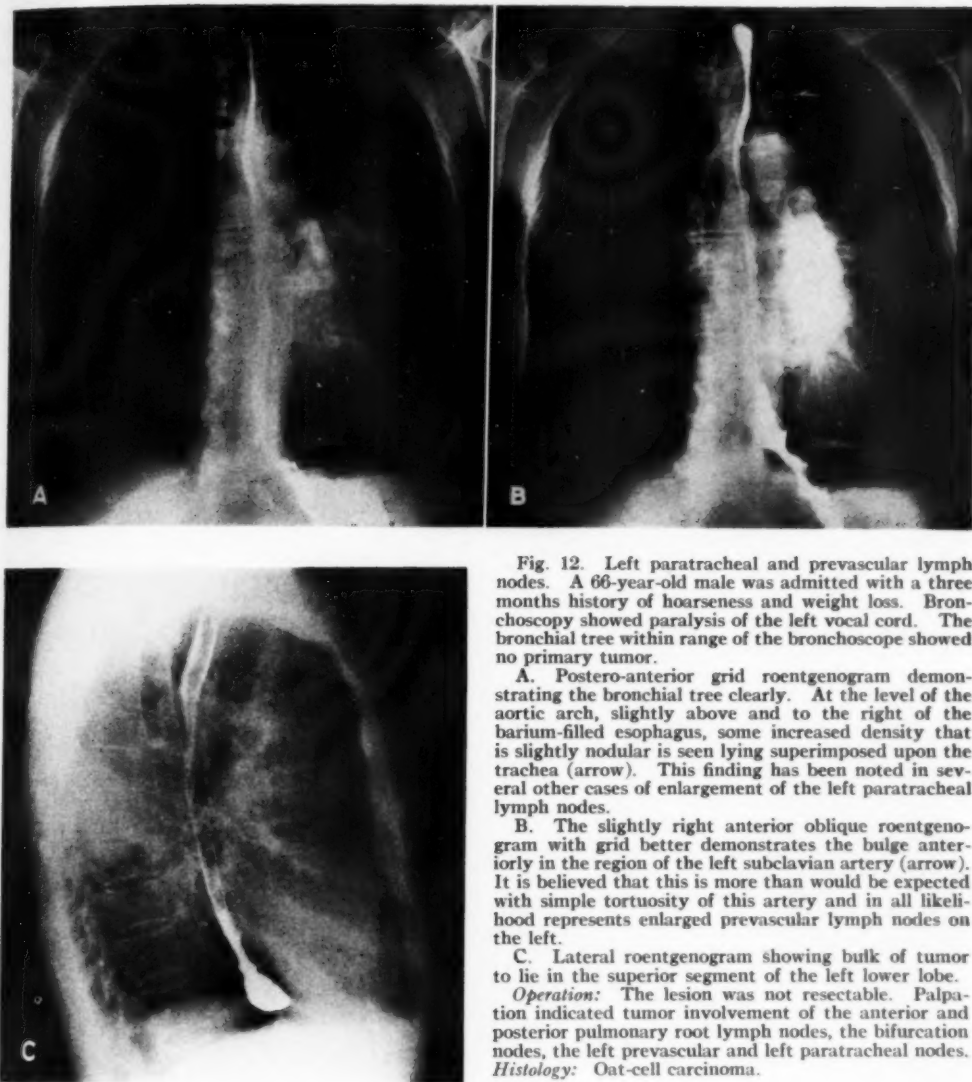


Fig. 12. Left paratracheal and prevascular lymph nodes. A 66-year-old male was admitted with a three months history of hoarseness and weight loss. Bronchoscopy showed paralysis of the left vocal cord. The bronchial tree within range of the bronchoscope showed no primary tumor.

A. Postero-anterior grid roentgenogram demonstrating the bronchial tree clearly. At the level of the aortic arch, slightly above and to the right of the barium-filled esophagus, some increased density that is slightly nodular is seen lying superimposed upon the trachea (arrow). This finding has been noted in several other cases of enlargement of the left paratracheal lymph nodes.

B. The slightly right anterior oblique roentgenogram with grid better demonstrates the bulge anteriorly in the region of the left subclavian artery (arrow). It is believed that this is more than would be expected with simple tortuosity of this artery and in all likelihood represents enlarged prevascular lymph nodes on the left.

C. Lateral roentgenogram showing bulk of tumor to lie in the superior segment of the left lower lobe.

Operation: The lesion was not resectable. Palpation indicated tumor involvement of the anterior and posterior pulmonary root lymph nodes, the bifurcation nodes, the left prevascular and left paratracheal nodes. *Histology:* Oat-cell carcinoma.

seen distorting or obliterating the fine line caused by the esophagus in relation to the medial margin of the right lung, being best demonstrated with barium in the esophagus (Fig. 14). In addition, enlarged bifurcation nodes tend to project posteriorly into the clear space behind the heart and anteriorly to the descending aorta (5). They may be seen on the lateral or oblique roentgenogram as a rounded area of soft-

tissue density surrounded by aerated lung (see Fig. 13).

Of the nodes in the posterior mediastinum, only those lateral to the esophagus or interposed between the aorta and esophagus can be demonstrated, and for this purpose the esophagus must be outlined.

The left anteromediastinal or prevascular chain of nodes is the major pathway in the drainage of the upper two-thirds of the left

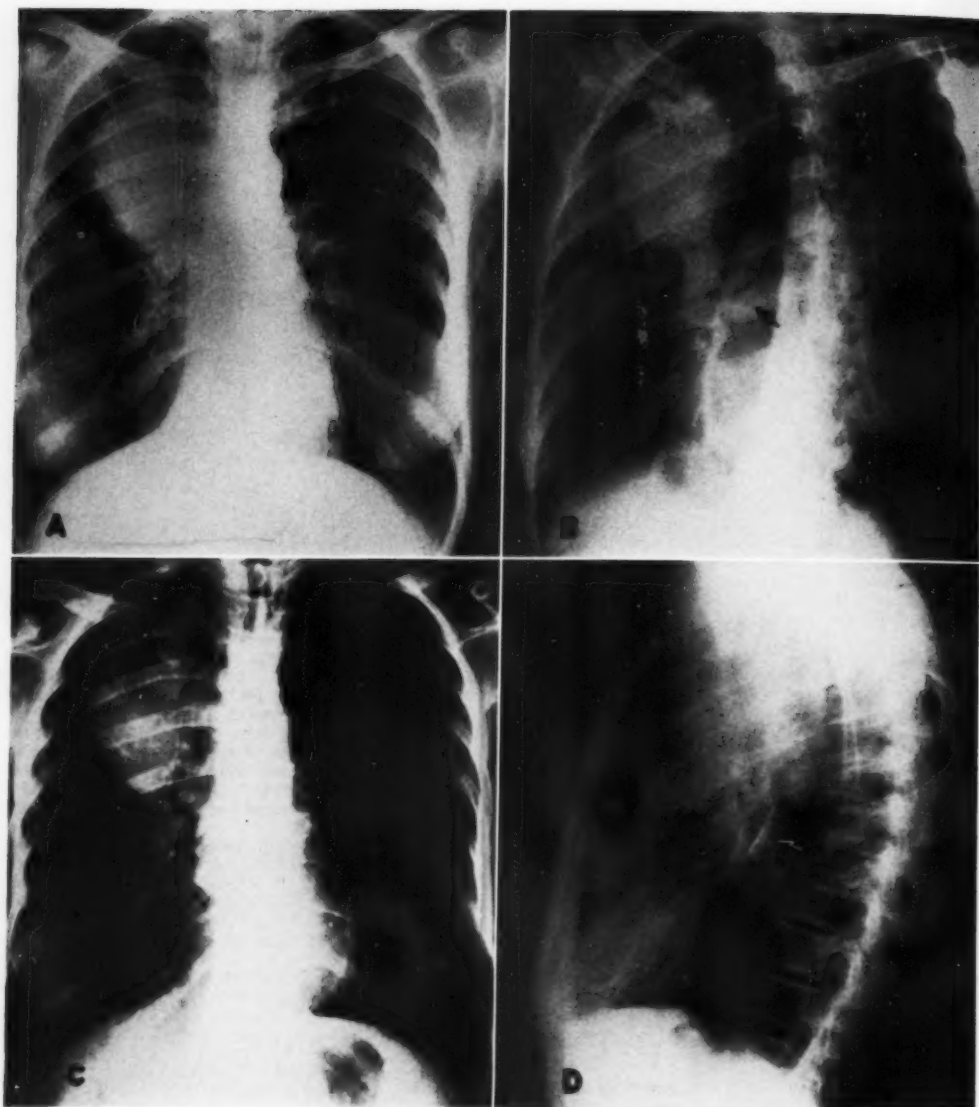


Fig. 13. Bifurcation lymph nodes. A 46-year-old female gave a seven months history of persistent cough following a "cold," weight loss, and intermittent subscapular pain. On bronchoscopy no intrabronchial tumor was seen.

A. Plain postero-anterior roentgenogram showing a mass in the right upper lobe and enlargement of the superior interlobar nodes.

B. Left anterior oblique roentgenogram showing slight widening of the coryna with indentation of the right main bronchus and a mass (arrow) extending posteriorly against the left main bronchus. In addition, anterior to and partially superimposed on the intermediate bronchus, the superior interlobar nodes are seen.

C. Postero-anterior grid roentgenogram demonstrating the tumor in the right upper lobe. In addition, a mass is seen below the right main bronchus (arrow).

D. Lateral roentgenogram showing a small amount of barium in the esophagus and extension of the enlarged subcorynal nodes posteriorly (arrow).

Operation: The primary tumor in the right upper lobe was found to be adherent to the vessels in the superior mediastinum; it was not resectable. Biopsies were taken from the primary lesion and from the bifurcation nodes. *Histopathology:* Squamous-cell carcinoma.

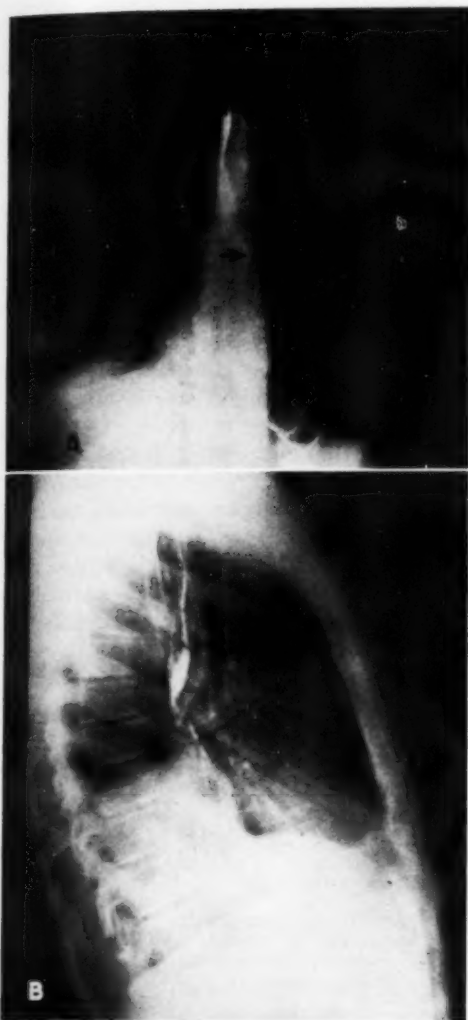


Fig. 14. Bifurcation and para-esophageal lymph nodes. A 53-year-old male entered with a seven months history of weakness, weight loss, chronic cough, and orthopnea. Bronchoscopy showed a mass at the level of the right upper lobe orifice.

A. Postero-anterior grid roentgenogram showing a tumor in the region of the right lower lobe. The marked displacement of the esophagus (arrow) is due to enlargement of the para-esophageal and bifurcation lymph nodes.

B. Lateral roentgenogram confirming the findings in the postero-anterior projection. There is collapse of the right lower lobe and fluid is present in the pleural cavity.

Operation: The tumor was not resectable. Numerous enlarged nodes, thought to contain tumor, were found at the inferior margins of the pulmonary root and bifurcation area and extending downward along the esophagus. *Histopathology* (lymph node): Metastatic squamous-cell carcinoma.

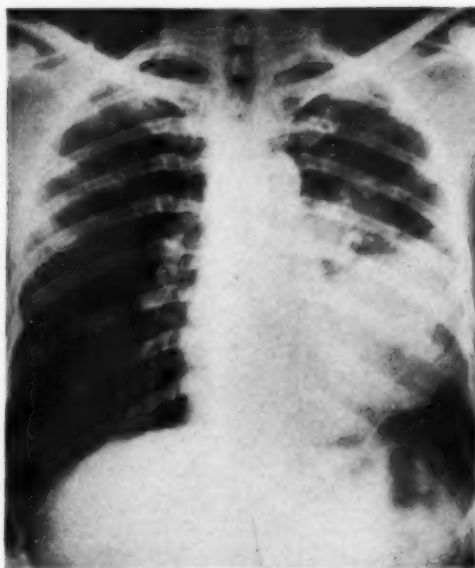


Fig. 15. Lymph node of the ductus Botalli. A 44-year-old male entered with a one year history of pain in the left chest, productive cough, dyspnea, wheeze, and weight loss. Bronchoscopy showed a mass partially obstructing the left lower lobe bronchus.

The plain postero-anterior roentgenogram shows a large tumor in the lower portion of the left lung, with irregular extensions above the level of the hilus. A 2.5-cm. round shadow of increased density overlies the left margin of the aortic arch and upper descending aorta (arrow). It is thought that this shadow represents the enlarged node of the ductus Botalli. Below it there are other shadows which represent involved lobar nodes.

Operation: Left pneumonectomy. It was not possible to remove all of the involved lymph nodes in the mediastinum.

Pathology: The primary tumor arose from and occluded the main lingular bronchus, extending from the hilus laterally to the pleural surface. Involved lymph nodes surrounded but did not obstruct the bronchi to the left upper and lower lobes. *Histology:* Squamous-cell carcinoma, grade III.

lung. Beginning with the node of the obliterated ductus Botalli, this chain extends superiorly in front of the left carotid artery and inferiorly communicates with the left paratracheal chain by way of the subaortic node. The most important node in this chain, that of the obliterated ductus, lies deep within the vascular structures on the left side so that it must reach considerable size before it will extend beyond the margin of these structures and become visible (Fig. 15). On the postero-anterior film the nodes above the ductus node will cause a widening of the left superior medias-

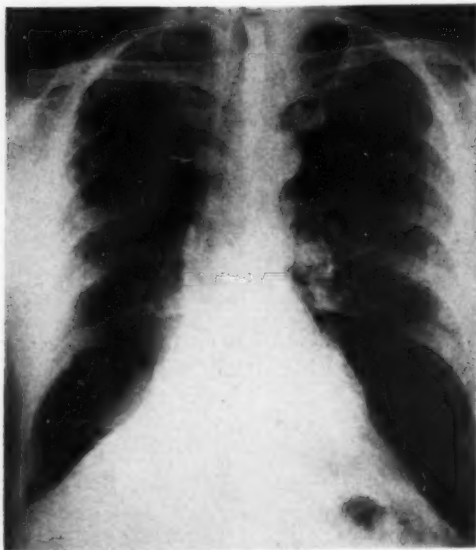


Fig. 16. Right prevascular lymph nodes. A 52-year-old male gave an eight-month history of weakness, dyspnea, wheezing, night sweats, weight loss, and occasional chills. Recently there had been severe sharp pain in the right chest. Bronchoscopy revealed a tumor obstructing the right intermediate bronchus.

The plain postero-anterior roentgenogram shows collapse of the right lower and middle lobes due to a tumor in the region of the intermediate bronchus. There is enlargement of the interlobar, bifurcation, and right prevascular nodes. The latter are seen lying to the right of the trachea (arrow).

Operation: Right pneumonectomy. Enlarged lymph nodes were present in the pulmonary ligament as well as in the bifurcation. The right prevascular node was biopsied but not removed. *Histopathology:* Oat-cell carcinoma.

tinum and may be seen either as an area of nodular density anterolaterally to the left side of the trachea (see Fig. 12), or in the lateral film as a projection into the clear retromanubrial space. A similar appearance can be produced by a tortuous left subclavian artery.

The *right anterior mediastinal or prevascular chain of nodes* is less often involved than the left. In two patients in whom these nodes enlarged by metastatic tumor were demonstrated, the postero-anterior roentgenogram showed that they projected to the right of the trachea and the lateral film that they lay anteriorly (Fig. 16).

DISCUSSION

In the presence of an undiagnosed lung tumor, enlarged lymph nodes in the path-

way of lymph drainage from the area in question strongly favor a malignant process rather than a benign one. The regional lymph nodes may be enlarged in the presence of infection, but if infection and carcinoma are coexistent, it is not possible to tell whether the enlargement is due to the one or the other, except when metastatic carcinoma extends beyond the capsule of the lymph node and invades the mediastinal structures, as in the case of laryngeal paralysis. In this investigation, it has seemed that lymph nodes which have enlarged sufficiently to be demonstrable roentgenographically often contain metastases.

When enlarged lymph nodes are visualized in the presence of carcinoma of the lung, they should be identified and so described that they will be sought at operation or, if resection is contraindicated and radiation treatment is to be used, will be included within the field of treatment. (Enlarged lymph nodes are not always indicative of metastases and therefore do not contraindicate surgical intervention.)

It is not considered that all of the lymph nodes of the mediastinum or the lung have been demonstrated with complete clarity or certainty. Further study and investigation must be carried out to elucidate this problem.

SUMMARY

1. This report is based on a study of 103 selected patients with proved primary carcinoma of the lung who at operation were found to have metastases to the regional lymph nodes.

2. Carcinoma of the lung spreads mainly by the lymphatic system, and the regional lymph nodes are most often involved by this spread. The occurrence of metastases to these nodes adversely affects the possibility of surgical cure.

3. The presence of metastases in the regional lymph nodes causes their enlargement and often makes their roentgen demonstration possible. The mechanisms by which this occurs are as follows: (a) the enlarged nodes project into the lung and

are visualized by virtue of their contrast with aerated lung; (b) they may cause an alteration in the normal contours of the mediastinal structures; (c) they may cause displacement of the mediastinal structures.

4. From the information available at the time this study was made, it has not been possible to determine a relationship between the segment of the lung involved by the primary tumor and the group of lymph nodes invaded by the metastases. It has been concluded, however, that when a given lobe of the lung harbors the primary tumor, certain lymph-node groups are more frequently involved than others.

5. Recognition of the presence and extent of the intrathoracic metastases will be of value to the internist, the surgeon, and the radiation therapist in planning treatment.

6. At the present stage of the investigation it is evident that a large amount of information is to be obtained in the future through close co-operation of the radiologist, the surgeon, the endoscopist, and the pathologist.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

El Diagnóstico Roentgenológico de las Metástasis del Carcinoma Pulmonar en los Ganglios Linfáticos Intratorácicos

Tomando por base 103 enfermos seleccionados con carcinoma primario comprobado del pulmón, en los que se descubrieron al operar metástasis de los ganglios linfáticos regionales, ofrécese ciertas observaciones pertinentes acerca de: (1) la relativa frecuencia de la invasión de una cadena ganglionar dada en relación con la localización anatómica del tumor primario y (2) el bastante constante aspecto radiográfico de dichos ganglios cuando los hipertrofian el tumor o una infección concomitante.

El carcinoma pulmonar se propaga principalmente por el aparato linfático, y en particular por depósitos de émbolos neoplásicos en los ganglios. La presencia de metástasis en los ganglios regionales y la consiguiente hiperplasia de los mismos permiten descubrirlos roentgenológicamente. Los ganglios hipertrofiados pueden proyectar en el pulmón y ser observados allí por virtud de su contraste con el tejido pulmonar aereado, o pueden provocar una alteración de los contornos normales o desplazamiento de los tejidos mediastínicos.

Por la información disponible en la fecha en que se hizo este estudio, no era posible determinar la relación existente entre el

segmento pulmonar afectado por el tumor primario y el grupo de ganglios linfáticos invadido por las metástasis. No obstante, se deduce que, cuando un lóbulo dado del pulmón alberga el tumor, ciertos grupos ganglionares se afectan más frecuentemente que otros. Por ejemplo, de 22 carcinomatosos con el tumor localizado en el lóbulo superior derecho, 16 tenían metástasis en los ganglios interlobulares superiores, 14 en los de la raíz del pulmón, 11 en la cadena paratraqueal derecha, 2 en los ganglios de la bifurcación y 3 en el grupo prevascular derecho. En 32 casos de tumor primario de las ramas mayores y menores del bronquio del lóbulo superior izquierdo, 16 revelaron metástasis en el ganglio interlobular, 22 en los ganglios de la raíz del pulmón, 12 en los ganglios prevasculares izquierdos, 2 en la cadena paratraqueal izquierda, 2 en los ganglios de la bifurcación, 1 en los prevasculares derechos y 2 en los paratraqueales derechos.

El reconocimiento de la presencia y extensión de la metástasis intratorácicas resultará de valor al internista, al cirujano y al radioterapeuta para planear el tratamiento.

Correlation of Postmortem Pathological Observations with Chest Roentgenograms¹

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A CORRELATION of postmortem pathological observations with roentgenograms of the chest provides the most factual information for the interpretation and diagnosis of thoracic lesions. Not infrequently the pathological and roentgen findings are at variance. These differences were observed to be due to the following causes:

(1) Terminal pathological changes, *i.e.*, changes occurring between the time the last film was taken and the patient's demise. Notable among the differences due to this cause is the variance in the amount of fluid in the pleural cavities. There was always more fluid postmortem whether the films had been obtained only a few hours or as long as forty-eight hours before death. Similar observations were made on other pathological conditions, as pneumonia, edema, atelectasis, etc.

(2) Lack of characteristic roentgenologic differences between several pathological entities.

(3) Inadequate portable roentgen equipment. The patients are sick, and the time factor for roentgenography is too long.

(4) Last, but not least, associated pathological findings which may obscure the picture. The greatest offender in this respect is fluid. In view of these considerations, the importance of a good clinical history is obvious.

In this paper we shall correlate the clinical features, the postmortem pathological findings, and the roentgen picture in pulmonary congestion, edema, embolism, infarction, pneumonia, and atelectasis. One of our primary objects is to determine how closely the x-ray findings and diagnosis agree with the postmortem study, and to ascertain causes of error. Most of the



Fig. 1. Method of postmortem x-ray examination. roentgenograms for the investigation were taken postmortem; a few antemortem films obtained within forty-eight hours of death are included.

PROCEDURE FOR POSTMORTEM X-RAY EXAMINATION

When permission has been granted for an autopsy, a chest film is taken in the upright position at a distance of 60 inches. The method of suspending the body has been simplified so that one person can carry out the roentgenographic procedure. The autopsy is then performed in the regular fashion. Routinely the X-ray Depart-

¹ From the Department of Radiology, Augustana Hospital, Chicago, Ill. Read before the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10-15, 1950.

ment receives a copy of the gross and microscopic pathological report.

The wrists of the patient are secured to the thighs by soft gauze loops. The body is supported by slings under the arms looped over the ends of a short metal bar on the mobile lower end of an overhead block-and-tackle system (Fig. 1). A soft gauze loop is placed around the head and sup-

porting slings, so as to stabilize the head. The body is raised to a vertical position and the ropes of the block and tackle are secured to a cleat on the wall. The cassette is positioned in front of the chest by an adjustable hanger attached to the bar which supports the patient. The portable x-ray machine, which is a part of the morgue equipment, is then positioned accurately behind the patient and a postero-anterior exposure is made.

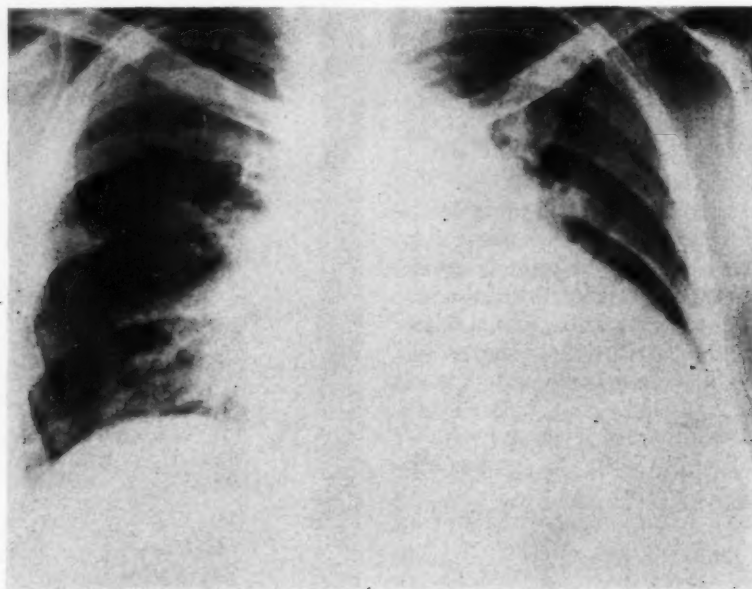


Fig. 2. Pulmonary congestion and Grade I edema. Left ventricular hypertrophy and dilatation secondary to hypertension. Heart 490 gm.

porting slings, so as to stabilize the head. The body is raised to a vertical position and the ropes of the block and tackle are secured to a cleat on the wall. The cassette is positioned in front of the chest by an adjustable hanger attached to the bar which supports the patient. The portable x-ray machine, which is a part of the morgue equipment, is then positioned accurately behind the patient and a postero-anterior exposure is made.

PULMONARY CONGESTION AND EDEMA

The most common causes of pulmonary congestion and edema are: (1) left ventricular failure secondary to arterial hypertension; (2) coronary artery disease and

disturbances in the pulmonary circulation: (1) an increase in the volume of the blood contained in the pulmonary vessels, (2) increased pulmonary pressure leading to arteriosclerosis of the pulmonary arteries, and ultimately to right ventricular failure, and (3) a decrease in the velocity of blood flow through the pulmonary circuit. It should be noted that pulmonary congestion is, with rare exceptions, inseparably related to pulmonary edema. The commonest cause of pulmonary edema is generally considered to be left ventricular failure in the presence of a competent right ventricle which continues to pump blood into the pulmonary vascular bed. The increased pressure in the pulmonary system causes filtration into

the alveoli, resulting in edema of the lungs.

This study is based upon 100 patients who could be adequately evaluated pathologically and roentgenologically, of whom 57 had chronic passive congestion and chronic edema. Females were slightly in excess of males. The highest incidence was between the ages of fifty and sixty years. Seventy-five per cent of the cases were

in 63 per cent, mitral heart disease in 11 per cent, and coronary artery disease with thrombosis, with or without infarction, in 41 per cent. Other causes for acute pulmonary edema were maternal pulmonary embolism from amniotic fluid, and lobar pneumonia.

Roentgen Findings: The x-ray features of pulmonary congestion and edema are

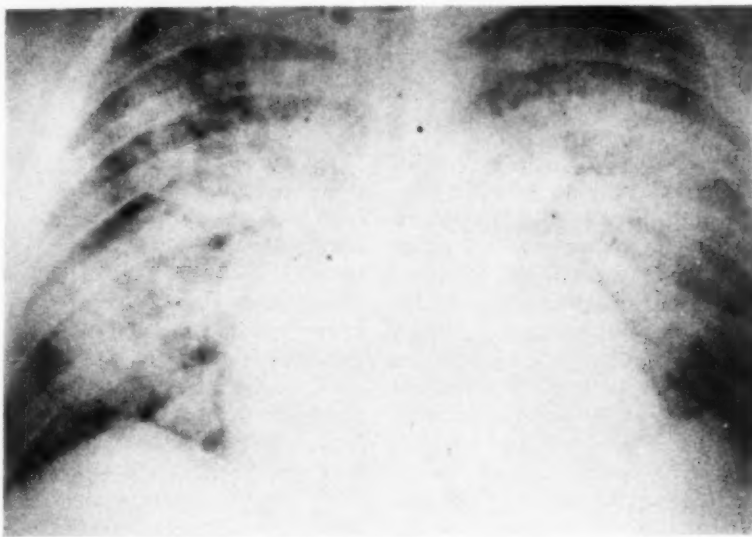


Fig. 3. Acute pulmonary edema of both lungs; symmetrical "butterfly" densities. Hypertrophy and dilatation of heart with concentric hypertrophy of left ventricle.

medical and 25 per cent surgical. Shortness of breath and cough were the cardinal symptoms. Hemoptysis occurred in only 18 per cent of the series. The salient postmortem findings were: (1) chronic heart failure in 81 per cent, usually left ventricular; (2) hypertensive heart disease in 47 per cent; (3) mitral heart disease in 11 per cent.

Sudden left ventricular failure is the most common cause of acute pulmonary edema. In this study acute edema was present in 27 per cent. Males slightly outnumbered females. The highest incidence was again between the ages of fifty and sixty. The cardinal symptoms were: (1) severe shortness of breath, (2) cyanosis, and (3) a bloody, frothy sputum, which occurred in 22 per cent. The postmortem findings were hypertensive heart disease

related to the underlying mechanism producing the pathological physiology. Simple engorgement of the blood vessels without significant transudate in the alveoli is revealed in an accentuation of the hilar shadows and the adjacent lung markings, the latter representing dilated blood vessels, namely, veins and arteries. The appearance of the congested lung varies, dependent upon whether the condition is acute or chronic. In the chronic condition (Fig. 2) there is a definite increase in the vascular pattern, and, in addition, there are numerous minor shadows which are usually indicative of edema. In sudden left ventricular failure, acute pulmonary edema manifests itself rather characteristically by a cloudiness of the central portion of the lungs, which has a fan-like form

or butterfly appearance (Fig. 3), with the apices, periphery, and bases of the lungs relatively clear. In some instances, however, the collections of fluid in pulmonary edema may assume atypical or bizarre forms simulating sometimes the appearance of pneumonia, consolidation, or atelectasis, and rarely they may show a miliary distribution. In typical cases the distinction from pneumonia, pulmonary infarct, and atelectasis will not be difficult, but in atypical cases repeated check-ups and a good clinical history are important.

PULMONARY EMBOLISM AND INFARCTION

Massive occlusion of a main branch of the pulmonary artery by an embolus usually causes instant death. If, however, an artery of medium size, or smaller, is involved and sufficient time elapses, pulmonary infarction will probably result. It is our experience that infarcts occur almost exclusively in connection with stasis of the pulmonary circulation from cardiac insufficiency. Exceptions to these findings have been observed by Hampton and Castleman. In this study 13 per cent of the patients had pulmonary embolism and 11 per cent infarcts. The source of the emboli was not routinely sought. Therefore, statistics as to location cannot be given.

Embolism occurred twice as frequently in the female as the male, and most commonly between the ages of fifty and sixty. None of the patients was under the age of forty; 93 per cent of the cases were medical and 7 per cent surgical.

The symptoms of pulmonary embolism varied according to the degree of involvement. The most common symptoms were chest pain, cough, hemoptysis, fever, shock, cyanosis, dyspnea, and apprehension, with eventual death. It was interesting to observe that no emboli arose from the right heart. One unusual case was that of a maternal pulmonary embolism from amniotic fluid.

The most common symptoms of infarction were cough, pleural pain, shortness of breath, and cyanosis; over one-half of the

patients had an elevation of temperature. Friction rub was unfortunately not recorded in most of the cases. Hemoptysis was recorded in only 27 per cent. We consider the cardinal evidences of infarction to be a history of pleural pain, hemoptysis, and thrombophlebitis.

Postmortem Findings: In 23 per cent of our cases of emboli, massive embolism occurred, blocking off the right and left main branches of the pulmonary artery, with no infarction. The absence of infarcts was due to sudden death. Emboli occurred also in the right middle and lower lobe pulmonary arteries, with infarcts in these lobes. In some cases there were bilateral multiple emboli in the secondary branches of the pulmonary artery throughout both lungs, predominantly in the right and left lower lobes, with associated infarcts. In other cases emboli occurred in the right lower lobe with infarction, and in still others in both right and left lower lobes with infarction. Infarction was observed in the right lower lobe as a result of bronchogenic carcinoma occluding the artery and bronchus to this lobe.

Roentgen Appearance of Infarcts: Infarcts often appeared roentgenographically as a slight increase in density at the base of a lung field, not infrequently with blurring or obscuring of a portion of the shadow of the diaphragm; frequently there were several densities, always peripheral in location. Elevation of the diaphragm was not an uncommon feature. The early infarcts, which may be seen from twelve to twenty-four hours after the onset, often have the appearance of bronchopneumonia. The shape of the infarcts was more usually dependent upon the portion of the lung involved; size and shape varied with underlying condition as well as the age of the infarct. The medial margin is convex in shape. When the infarct was not obscured by fluid, and particularly when it was located at the costophrenic angle, the medial border had the form of a "hump" (Fig. 4). The process of organization may begin after the second week. It is not uncommon to see a scar of an old infarct in



Fig. 4. Infarction in right middle and lower lobes. Note the convex shape of the medial region; "hump" sign.

Fig. 5. Infarcts in right middle and lower lobes obscured by fluid. Postmortem examination revealed thromboses of the right femoral artery and vein.

the form of a linear shadow. Many of these features have been well described by Hampton and Castleman (1).

Postmortem there were some findings which were not specifically observed radiographically. In one case in which the

roentgenogram showed no infarction and gross postmortem examination revealed neither infarction nor embolism, the microscopic examination disclosed an infarct, the location of which was not stated. In a second case, in which postmortem study revealed a right lower lobe infarct, a considerable amount of fluid in the right pleural cavity was demonstrated roent-

a considerable amount of fluid in the right pleural cavity with probable consolidation, consistent with a pneumonic process associated with hypertrophy and dilatation of the heart (Fig. 6). Postmortem examination showed 500 c.c. of fluid occupying the right pleural cavity, and infarction of the right middle and lower lobes with a bronchopneumonic process.



Fig. 6. Infarcts in right middle and lower lobes. Heart increased in size (weight 780 gm.); congestive heart failure. The findings in the right lung simulate a pneumonic process. Postmortem examination showed associated bronchopneumonia.

genographically (Fig. 5); no definite statement was made regarding an infarct.

In a third case the roentgenogram revealed no evidence of infarction, but at autopsy emboli were seen in the secondary pulmonary branches on the right and left side, with multiple small infarcts.

In a fourth case the roentgenogram showed numerous shadows which were diagnosed as consistent with metastases. Autopsy showed an embolus but there were no infarcts, and numerous metastatic nodules were present which had their origin in a carcinoma of the prostate gland.

The roentgenogram in a fifth case revealed

In the study of these cases it became obvious that infarcts must be differentiated from pneumonia and atelectasis and that pleural effusion is a prime offender for obscuring infarction.

Roentgen Appearance of Embolism: Massive pulmonary embolism is such a catastrophic clinical event that radiography is rarely done. In this survey no case of pulmonary embolism was diagnosed roentgenographically by Westermarck's criteria (2). Roentgen diagnosis was made indirectly on the basis of infarction. In our cases of massive pulmonary embolism without infarction we did not observe a

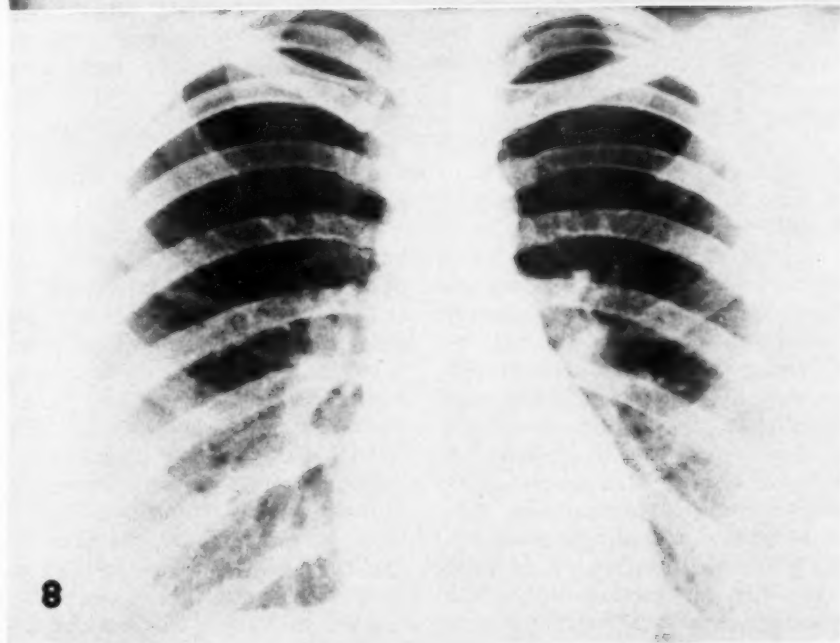
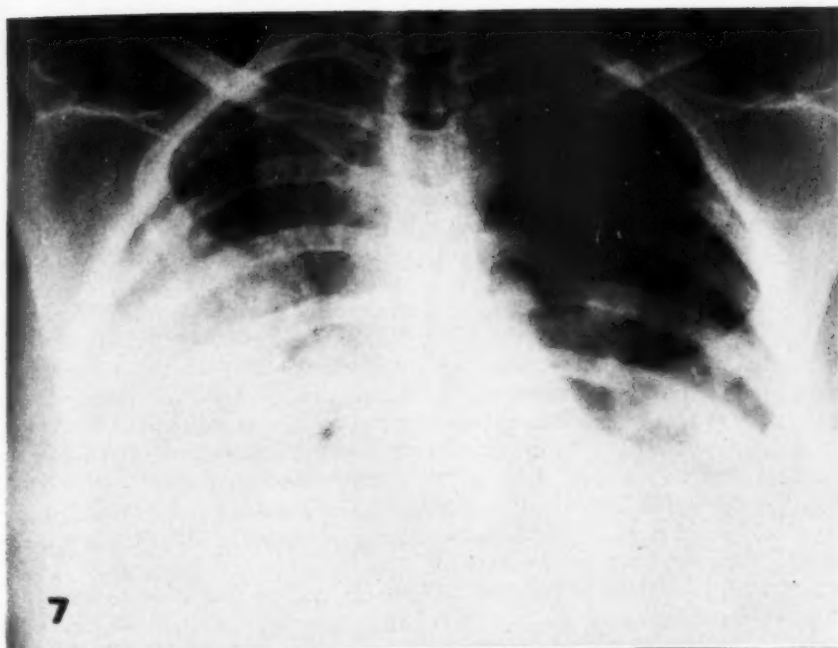


Fig. 7. Pulmonary edema with bronchopneumonia. Asymmetrical "butterfly" densities, more marked at hilus. Apices, periphery on the left, and bases relatively clear. Result of maternal pulmonary embolism by amniotic fluid.

Fig. 8. Same case as Fig. 7. Film taken one year prior to fatal episode, showing heart and lungs normal.

definite diminished vascular structure with increased radiability of the involved lung, nor did we note the abrupt or choked-off appearance of the central branches of the pulmonary artery. Westermarck shows roentgenograms illustrating these findings.

The diagnosis of maternal pulmonary embolism from amniotic fluid was made particularly with a knowledge of the clinical history (Figs. 7 and 8).

PNEUMONIA

In this study bronchopneumonia occurred in 32 per cent and lobar pneumonia in 2 per cent of the cases. No attempt was made to determine the type of organism. It was interesting to observe that there were slightly more females than males. The greatest incidence of pneumonic findings was observed between the ages of fifty and sixty. Sixty-five per cent of the cases were medical and 35 per cent surgical. The only symptoms in pneumonia which need be mentioned here are hemoptysis, which occurred in 26 per cent, and pain, which occurred in 23 per cent.

Postmortem Findings: The distinctive feature of bronchopneumonia is a nodular consolidation. The nodules may be as small as miliary tubercles or so large that the normal lung tissue is reduced to a minimum. The bronchi, as well as the trachea, are congested, and the surface is covered with a purulent exudate. The bronchial mucosa and wall are infiltrated with cellular elements involving the connective-tissue stroma of the lung. The affected parenchyma reveals patchy consolidations and inflamed bronchi leading into the involved portions. On section, areas of emphysema and atelectasis are seen, often adjacent to solidified lung tissue.

Eighty per cent of this group had chronic left heart failure and of these 35 per cent had hypertension and 12 per cent coronary thrombosis. Hypostatic bronchopneumonia was sometimes associated.

Roentgen Features: A patchy or lobular pneumonitis was the most common finding, usually involving the lower lobes and almost always extending out to the periph-

ery (Fig. 9), though involvement of the upper lobes was frequent. Associated with these findings were passive congestion, atelectasis, and emphysema such as are not infrequently seen at this age. As a rule, the disease was bilateral. Not infrequently the patches became confluent and had the appearance of lobar pneumonia.

In the differential diagnosis one must consider the findings sometimes seen in congestive heart failure, particularly with hypostatic bronchopneumonia (Fig. 10), and occasionally in some types of bronchiectasis. Infarction may sometimes have to be considered, but as a general rule the differential diagnosis of bronchopneumonia is not difficult.

Lobar Pneumonia: As previously stated, lobar pneumonia occurred in 2 per cent of this series. The features of lobar pneumonia are very well understood. Attention may be called, however, to the not uncommon association of a bronchogenic carcinoma, or occasionally an adenoma of the bronchus, with a lobar pneumonic process.

ATELECTASIS

Atelectasis is a state of partial or complete airlessness in the lung. It is to be distinguished in its pure form from inflammatory consolidation, congestion, and pulmonary edema. Atelectasis may be either congenital or acquired. Only acquired cases will be considered here.

In this study, atelectasis was a terminal finding except for a few cases. The symptoms and signs are associated with or related to the etiologic agents, e.g., a mucous plug in a postoperative case or a bronchogenic carcinoma. The classical signs of obstructive atelectasis (Figs. 11 and 12) are (1) decrease in the size of the involved hemithorax; (2) a shift of the trachea and other mediastinal structures toward the involved side; (3) elevation of the diaphragm with dullness to percussion; (4) absence of breath sounds over the involved lobe. In many cases, dependent upon the site of the process, the appearance and position of the hilus and the septa

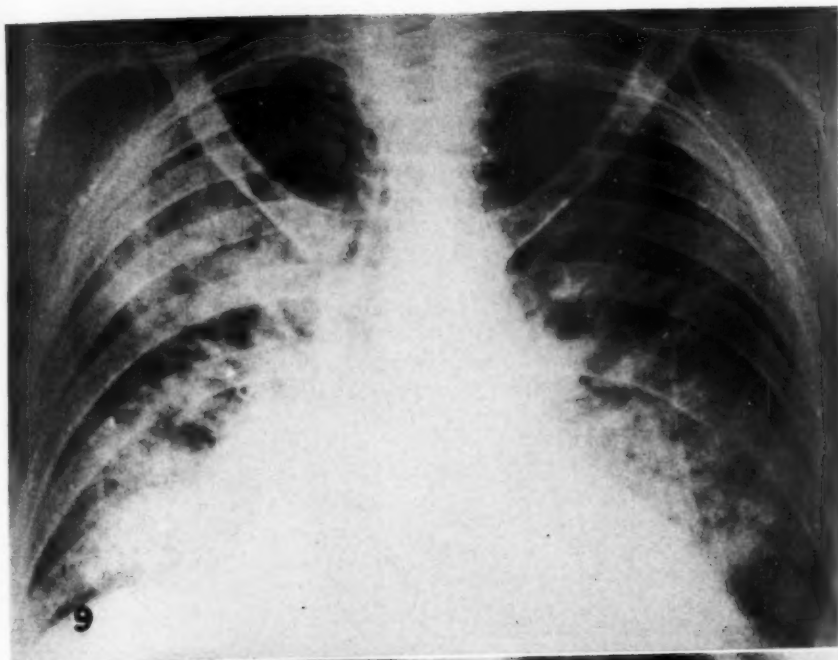


Fig. 9. Acute pulmonary edema and bronchopneumonia. Fairly symmetrical density involving both lungs, greatest at the hilus. The pneumonic process extends to the periphery in the right upper lobe region. Hypertensive heart disease.

Fig. 10. Basilar bilateral patchy edema, also consistent with hypostatic pneumonia.

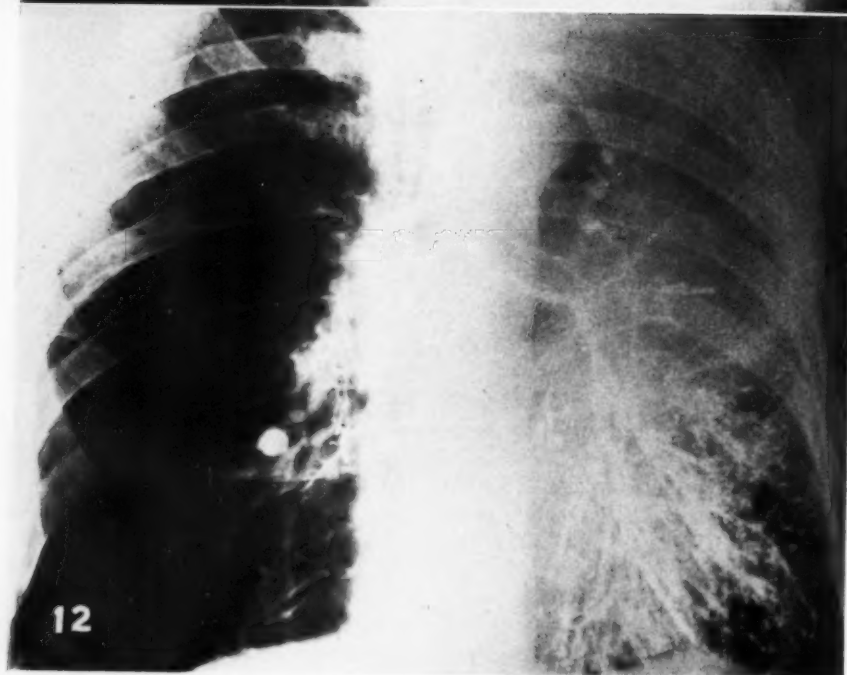


Fig. 11. Atelectasis of left upper lobe consistent with bronchostenosis, most frequently due to carcinoma. Bronchoscopy and bronchography advised.

Fig. 12. Bronchogram of case shown in Fig. 11. The bronchial tree is not visualized in the left upper lobe region. Mediastinal contents drawn to involved side. Findings consistent with bronchogenic carcinoma. Postmortem examination revealed a bronchogenic carcinoma of the left upper lobe, involving the main bronchus and replacing most of the lobe; atelectasis peripheral to the obstruction.

of the lungs are more important and may be the first signs suggesting the diagnosis.

Postmortem Findings: There were numerous cases of terminal atelectasis which apparently was due to compression of the lower posterior edges as a result of body pressure, pleural fluid, and altered aeration. There were cases of left lower lobe atelectasis associated with bronchopneumonia; pulmonary collapse from pressure from without, namely, pneumothorax; and varying degrees of atelectasis from pleural fluid. Obstructive atelectasis was either the result of secretions or bronchogenic carcinomas.

Roentgen Features: The roentgen picture depends upon the nature of the obstruction, the degree of involvement, and the onset (whether acute or insidious), and also upon the lobe involved. If the bronchus is not entirely occluded there may not be any atelectasis. If the obstruction is in the main lobe bronchus, the entire lobe will probably be collapsed. Not infrequently there is an area of emphysema near the adjacent portion of the involved lung. When a whole lobe is involved, and particularly a lower lobe, the findings are rather striking, *i.e.*, the heart and mediastinal contents are shifted over to the affected side and the diaphragm is elevated. Shift of the trachea, however, is usually observed in upper lobe collapse.

It should be emphasized that occasionally the characteristic displacement of the

heart and mediastinal contents may be slight or even absent. It is in these cases that the appearance and position of the septa and hilus of the lung are of more importance and may be the first signs suggesting the diagnosis. In general, when the upper lobe is atelectatic, the compensating lower and middle lobes both move upward and anteriorly. When the middle lobe is completely collapsed, it is flattened and displaced medially. When the lower lobe is atelectatic, it is situated posteriorly and medially and comes to lie in the paravertebral gutter.

SUMMARY

1. The clinical picture, postmortem pathological observations, and x-ray findings of pulmonary congestion, edema, embolism, infarction, pneumonia, and atelectasis are correlated.

2. The causes for the variance between the postmortem and roentgen findings are discussed.

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SUMARIO

Correlación de las Observaciones Anatomopatológicas en la Autopsia con las Radiografías Torácicas

La correlación presentada comprende las características clínicas, observaciones anatomopatológicas en la autopsia y hallazgos roentgenológicos en una serie de casos que comprenden congestión y edema pulmonares, embolia e infarto pulmonares, neumonía y atelectasia. La mayor parte de las radiografías fueron tomadas post-mortem con una técnica especial descrita por los AA.

En la congestión y el edema del pulmón los sobresalientes hallazgos autopsicos con-

sistieron en insuficiencia cardíaca crónica, cardiopatía a base de hipertensión e insuficiencia mitral. Los hallazgos roentgenológicos se relacionan con el mecanismo subyacente que produce la fisiología patológica. Es fácil distinguir radiográficamente los casos típicos, de la neumonía, el infarto pulmonar y la atelectasia, pero en los atípicos revisten importancia las comprobaciones repetidas y una buena anamnesis clínica.

Se observó embolia pulmonar tanto con

como sin infarto. En el estudio de estos casos resultó manifiesto que hay que diferenciar los infartos de la neumonía y la atelectasia y que el derrame pleural es a menudo la causa de que se pase por alto el infarto.

En la bronconeumonía el característico hallazgo anatomopatológico es la hepaticización nodular. En el diagnóstico diferencial con los rayos X hay que tomar en cuenta los hallazgos a veces observados en la insuficiencia cardíaca congestiva y de vez en cuando en la bronquiectasia de ciertas formas. Quizás también haya que

considerar el infarto. Debe tenerse presente la no rara asociación de carcinoma broncogénico con un proceso de neumonía lobular.

Se observó atelectasia del lóbulo inferior izquierdo asociada con varios estados, tales como bronconeumonía, neumotórax y derrame pleural. La atelectasia oclusiva se debió bien a secreciones o carcinoma broncogénico. El cuadro roentgenológico varía conforme a la naturaleza de la obstrucción, la intensidad y sitio de la invasión y la iniciación (ya aguda o insidiosa).



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The Roentgen Diagnosis of Pericardial Effusion

With Special Reference to the Appearance of the Barium-Filled Esophagus and the Cardiohepatic Angle¹

GEORGE LEVENE, M.D., and SEYMOUR A. KAUFMAN, M.D.

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THERE IS NO SINGLE roentgenologic sign of pericardial effusion. Such errors in diagnosis as are frequently encountered are most often the result of an impression gained by inspection of the film alone, and a conclusion that the heart shadow resembles a "water-bottle." Since the contour of an enlarged heart may, in some cases, simulate the outline of a pericardial effusion, every bit of available evidence must be sought and weighed. Observations by various investigators have contributed substantially toward the diagnosis of pericardial effusion since the report of Camp and White (1) in 1932, which stated that in only one of 49 patients studied roentgenologically was the diagnosis of pericardial effusion established antemortem. The purpose of this paper is to summarize the most useful signs commonly employed and to present our own observations as to the diagnosis and differential diagnosis of pericardial effusion.

The pericardium is a membranous sac containing elastic fibers and consisting of a visceral and a parietal layer. While the visceral layer is more or less intimately adherent to the surface of the heart, the parietal layer is loosely applied. This creates an actual space between the two layers, which normally contains 15-20 c.c. of clear, straw-colored fluid. After rounding the inferior borders and surface of the heart, the pericardium becomes firmly attached to the central tendon of the diaphragm (Fig. 1). Superiorly, the pericardium is reflected onto the coats of the great vessels, with which it blends intimately. Anteriorly, the outer layer is loosely attached to the pleura by fibro-areolar tissue—the pleuro-pericardial membrane. At times,



Fig. 1. Calcified pericardium. The inferior surface of the parietal layer of pericardium is firmly attached to the central tendon of the diaphragm. The inferior vena cava (arrow) is also shown.

however, this membrane may consist of firm, dense, fibrous tissue. Attachment to the sternum is by the superior and inferior sterno-pericardial ligaments. The superior and inferior venae cavae pierce the pericardium posteriorly, as do also the four pulmonary veins. The ligamentum arteriosum is usually enclosed by pericardium, though occasionally it lies outside the attachment of the pericardial sac to the great vessels.

¹ From the Departments of Radiology, Massachusetts Memorial Hospitals and Boston University School of Medicine. Accepted for publication in February 1951.

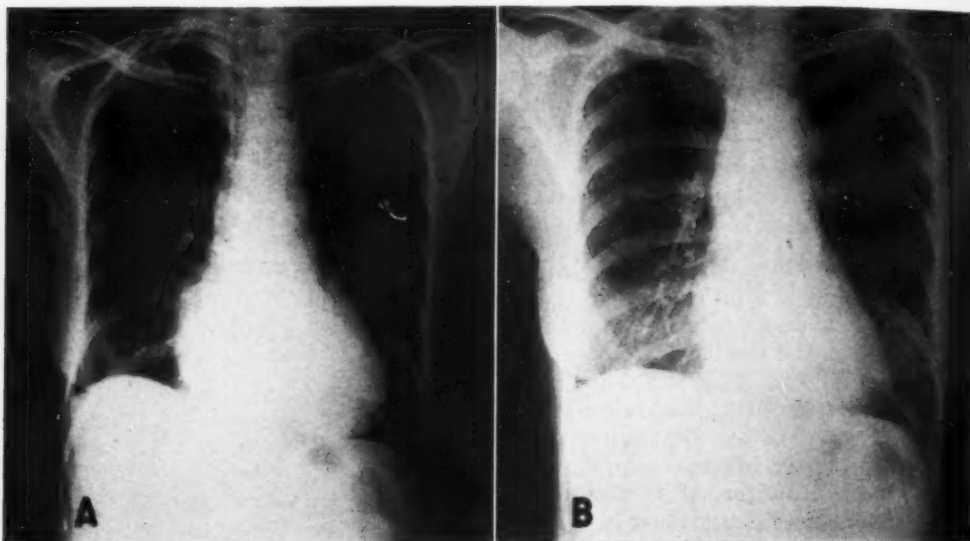


Fig. 2. A. Small pericardial effusion in a case of "myxedema heart." Note the acute cardiohepatic angle, the preponderance of length over transverse diameter, and the straight left cardiac border.
B. Same case two months later, after treatment with thyroid extract. The heart shadow is now normal in size and contour.

While fluid in the pericardium may, under certain circumstances, accumulate with startling rapidity, as for example in the case of trauma, the process is usually subacute or chronic, and it is with these forms that this paper is chiefly concerned. Fluid naturally gravitates to the most dependent portions of the sac. Most observers (2, 3) agree that amounts less than 250 to 300 c.c. may not be recognized roentgenologically. This may be due to the fact that the normal heart is subject to considerable variation in size before it may be considered enlarged, and unless a patient has been under roentgen observation for a sufficiently long period to show progressive increase in the size of the heart shadow, it may not be possible to tell, from a single examination, whether or not the shadow is abnormal. Fenichel and Epstein (4) have observed that there may be a straightening of the left cardiac border with amounts of 250 c.c. or less, though they feel that this sign is not thoroughly reliable.

Fortunately, interval examination is frequently possible. Here it will be observed that there is a progressive increase

in the size of the heart shadow. In the normal heart, the length is approximately 1.5 cm. greater than the transverse diameter (5, 6). In the early stages of pericardial effusion, the difference between length and transverse diameter becomes greater. At the same time, the cardiohepatic angle becomes more acute (Fig. 2).

Various writers (7, 8) stress the typical obtuse cardiohepatic angle in pericardial effusion. We are not concerned with the validity of this observation as it pertains to physical diagnosis. We do feel, however, that adherence to this dictum has prejudiced roentgenologic observation and has obscured the fact that an obtuse cardiohepatic angle, as seen on the roentgenogram, usually militates against the presence of pericardial effusion.

Since a good deal of emphasis will be placed on the cardiohepatic angle in this report, brief consideration may be given to the physical factors involved. This angle is normally formed by the intersection of the shadows of the right diaphragm and right atrium or inferior vena cava. Fluid in the pericardium is external to both the

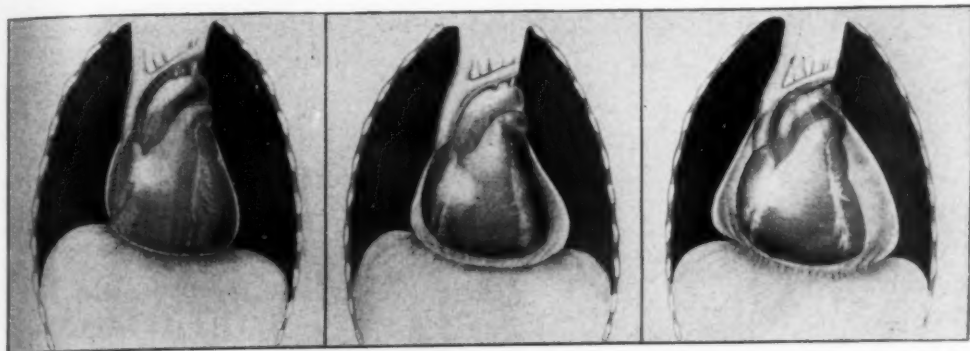


Fig. 3. Semidiagrammatic illustrations showing how the acute cardiohepatic angle is produced in the evolution of pericardial effusion.

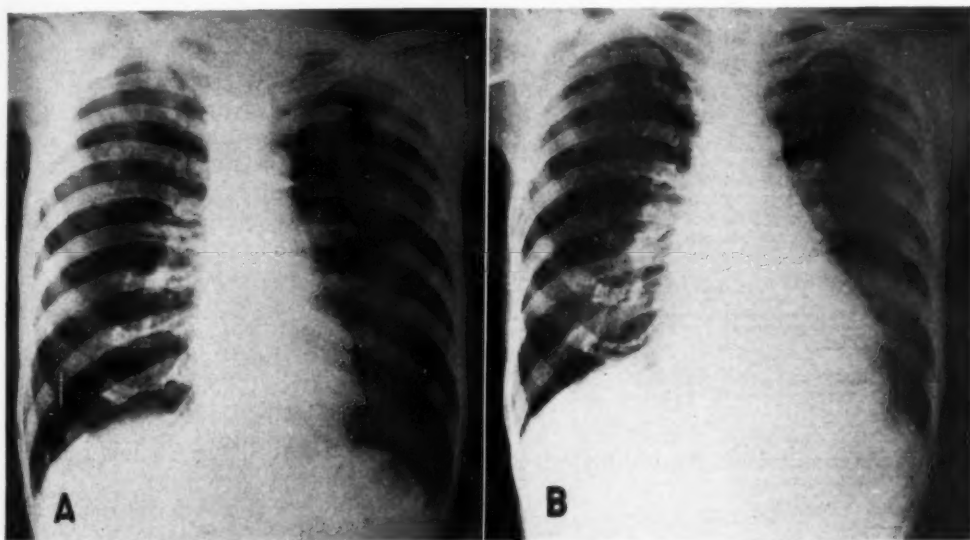


Fig. 4. Films of patient with panarteritis nodosa.

- A. At this time no abnormality of the heart was recognized.
 B. Ten months later pericardial effusion has developed. Note the increase in the length of the heart shadow and the acute cardiohepatic angle. There has been no change in the width of the vascular pedicle.

right atrium and inferior vena cava. Increasing amounts of fluid cause progressive lateral bulging of the pericardial sac *above* its fixed attachment to the diaphragm. It becomes apparent that, as the amount and weight of the fluid increase, the cardiohepatic angle becomes smaller, since the position of neither the right atrium nor inferior vena cava is involved (Fig. 3). The space between the visceral and parietal layers of pericardium will accommodate approxi-

mately 250 c.c. of fluid before the pericardium begins to bulge. For this reason, an effusion less than this amount is insufficient to alter the cardiohepatic angle and is most difficult to recognize.

As the amount of fluid increases, distinctive changes in the cardiovascular shadow and adjacent structures are produced. There is further increase in the length of the heart shadow and there is a widening of the transverse diameter so that, as the

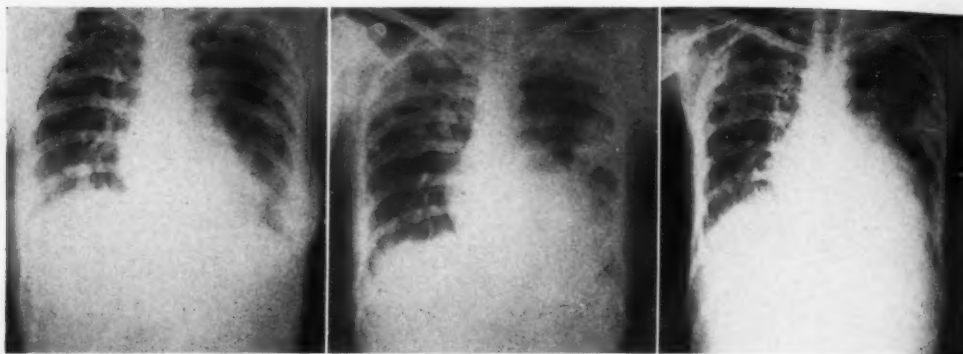


Fig. 5. Successive films in a case of pericardial effusion due to panarteritis nodosa associated with active pulmonary tuberculosis. Note the progressive symmetrical enlargement of the heart shadow and the acute cardiohepatic angle. The vascular pedicle is relatively small.

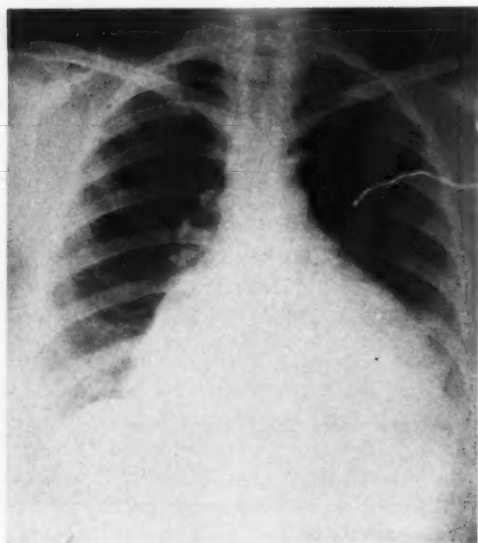


Fig. 6. Tuberculous pericarditis. The transverse diameter of the cardiac shadow exceeds the length. The anatomic landmarks on the left are obscured, though the ascending aorta still appears normal. The vascular pedicle is small and the cardiohepatic angle markedly acute.

amount of fluid in the pericardium increases, the transverse diameter may equal or exceed the length. The cardiohepatic angle becomes more acute (Figs. 4-6). The junction between the left auricle and left ventricle becomes obliterated. This change takes place long before the junction of the right atrium and vascular arch is obscured. Fluoroscopically, the amplitude

of cardiac contractions is markedly diminished, and, with larger effusions, pulsations may be imperceptible except in the region of the vascular pedicle. The appearance of the latter constitutes a striking feature of the cardiovascular shadow in large pericardial effusions, for, while the cardiac shadow may be enormously enlarged, the shadow of the great vessels usually remains small (Figs. 7 and 8). On the other hand, the shadow of the great vessels in cases of ventricular failure is almost invariably widened. The lung fields are relatively clear unless there is associated disease (azotemic edema, pneumonia, etc.). Study of the barium-filled esophagus will show a concave pressure deformity and esophageal displacement similar to that caused by an enlarged left atrium. The defect will be lower in the esophagus, however, than that produced by left atrial enlargement. It is important to note that in either case the deformity of the esophagus appears as one smooth, continuous curve (Fig. 9). This observation is of considerable importance in the differential diagnosis of enlargement of the heart due to ventricular failure.

Arendt (9) has called attention to the poor visualization of the tracheal bifurcation in cases of pericardial effusion, and has also pointed out that in these cases the angle of the carina is not widened. Conversely, a wide angle of tracheal bifurcation (100 de-

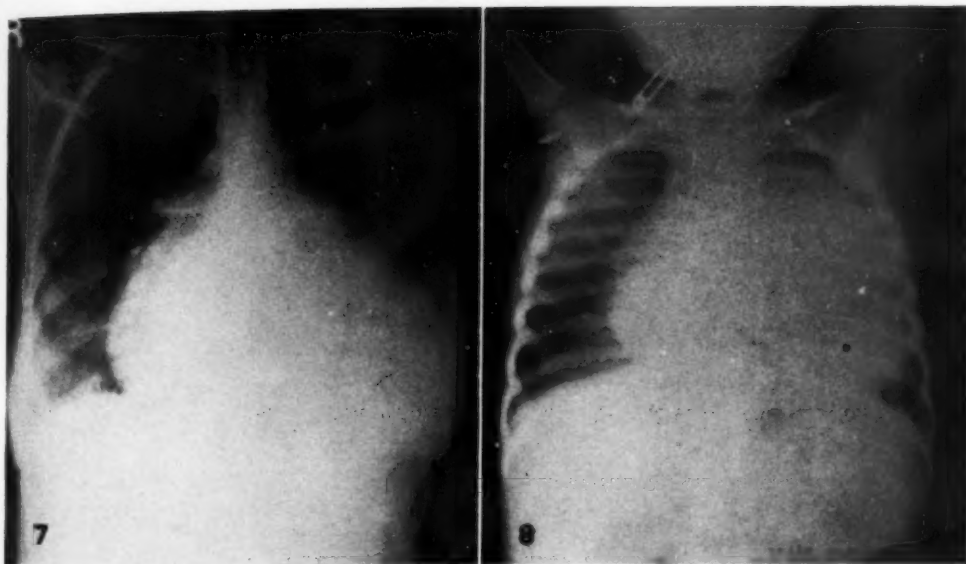


Fig. 7. Hemorrhagic pericardial effusion (1,800 c.c.) in a patient with myxedema. The contour of the vascular pedicle has become altered. The lung fields are relatively clear. The cardiohepatic angle is acute.
 Fig. 8. Empyema of the pericardium due to hemolytic streptococcus. The shadow of the vascular pedicle is markedly widened. This occurs only with very large effusions.

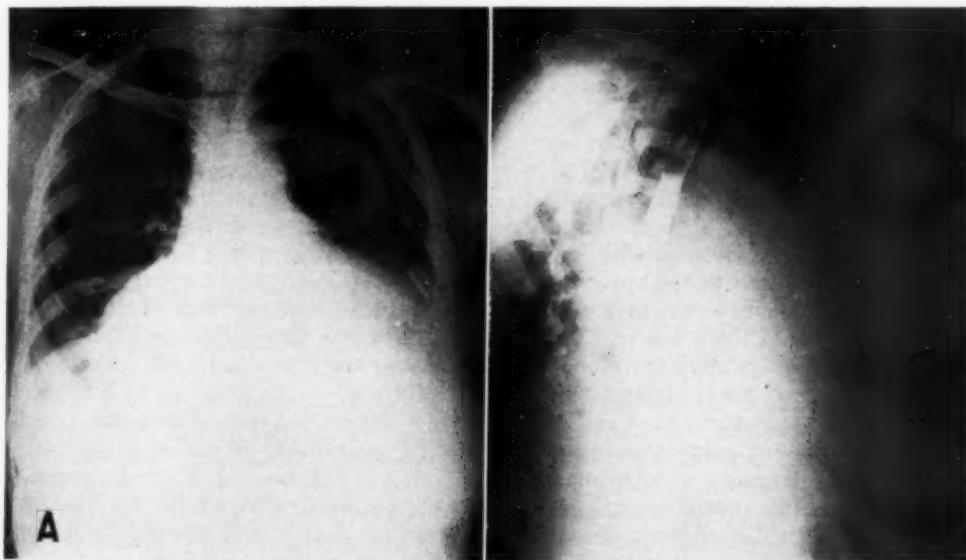


Fig. 9. Pericardial effusion in a case of uremia.
 A. The cardiovascular junction on the right is still well preserved.
 B. The barium-filled esophagus is displaced backward in one smooth, continuous curve. This is lower down than the deformity produced by an enlarged left atrium.

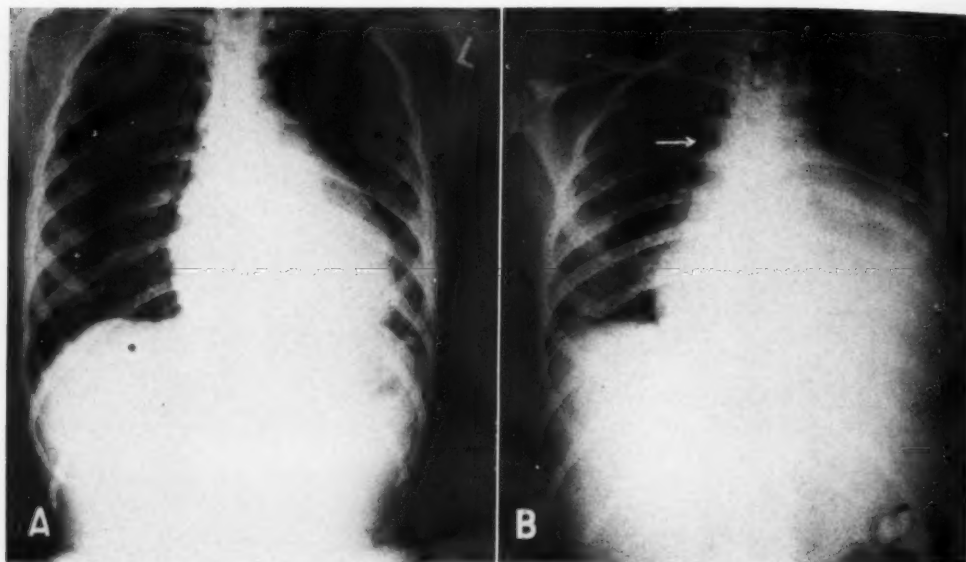


Fig. 10. Pericardial effusion in a case of lupus erythematosus.

A. The effusion has produced an increase in the transverse diameter and the length of the cardiac shadow. The cardiohepatic angle is acute. There is minimal widening of the vascular pedicle.

B. Four days later. The vascular pedicle is wide and the superior vena cava (arrow) plainly visible. The cardiohepatic angle is acute.

grees or more) tends to exclude the possibility of pericardial effusion as the sole cause of the enlarged heart shadow.

Golden (10) has recently proposed a new observation for the diagnosis of pericardial effusion. He pointed out that, as seen in the lateral view, the retrosternal space is normally clear and that with pericardial effusion it is obscured. It must be recalled, however, that the heart is normally in contact with the left half of the lower portion of the body of the sternum and with the costal cartilages of the left fourth, fifth, and sixth ribs. This sign may therefore be of value in detecting only the larger effusions.

Williams and Steinberg (11) and others (12) have employed angiocardigraphy as an aid in the diagnosis of pericardial effusion. While this procedure may be safe in cases of pericardial effusion, it must be remembered that the condition with which the latter is most often confused is the heart in ventricular failure. It would appear that such a heart should be spared the strain of so rigorous a diagnostic procedure.

When the amount of fluid in the pericar-

dium has reached the limit of distensibility of the sac, the intrapericardial portions of the venae cavae become compressed, resulting in an elevation of venous pressure and congestion of the liver. The latter will cause elevation of the right diaphragm. Pressure on the superior vena cava causes widening of its supracardiac shadow so that it is plainly seen on the roentgenogram (Fig. 10). Any form of heart disease may produce an enlarged heart which may be confused with pericardial effusion. Usually, however, there are some points of distinction, which may be readily identified by careful study. Engle *et al.* (13) have recently reported a case of congenital cardiopathy mistakenly diagnosed as pericardial effusion. The case of Ebstein's anomaly of the tricuspid valve which they described is so rare that it will probably not come within the experience of many roentgenologists and need not be considered as an important lesion in differential diagnosis. Rheumatic heart disease may simulate the contour of pericardial effusion. An error early in our experience has taught us not



Fig. 11. Semidiagrammatic illustrations showing how dilatation of the right ventricle tends to produce an obtuse cardiohepatic angle. This occurs in right ventricular failure. The angle again becomes smaller with restoration of cardiac tone and recovery of compensation.

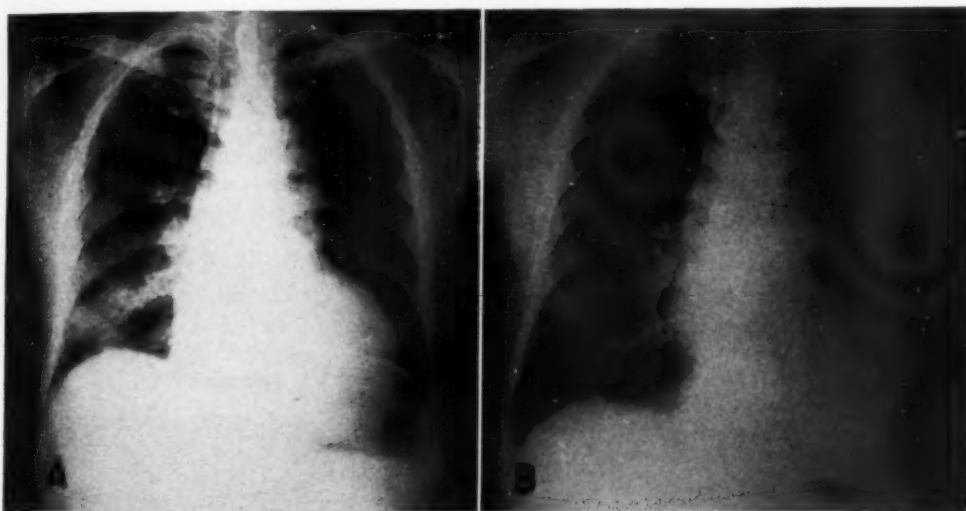


Fig. 12. Ventricular failure occurring in a case of hypertensive heart disease.

- A. Film taken with diminished intrathoracic pressure (Mueller test).
 B. Film taken with increased intrathoracic pressure (Valsalva test). Such marked change in size does not occur with pericardial effusion.

to make a diagnosis without fluoroscopic examination. The amplitude of pulsations will almost certainly permit a distinction between these two conditions.

In any form of heart disease, long continued strain or the weakened condition of the diseased myocardium may result in ventricular failure. Left ventricular failure produces congestive infiltration and edema of the lungs. At this time a systolic murmur is heard at the apex of the heart. Concomitant with, or as a result of the in-

creased pulmonary tension imposing a further strain on an already weakened right ventricle, the latter fails. At this time, the patient usually exhibits ankle edema, ascites, increased venous pressure, and prolonged circulation time. A systolic murmur may be heard at the tricuspid orifice. Frequently, there is some clearing of congestive infiltration of the lungs. Roentgenologically, the heart in right and left ventricular failure is not infrequently mistaken for pericardial effusion.

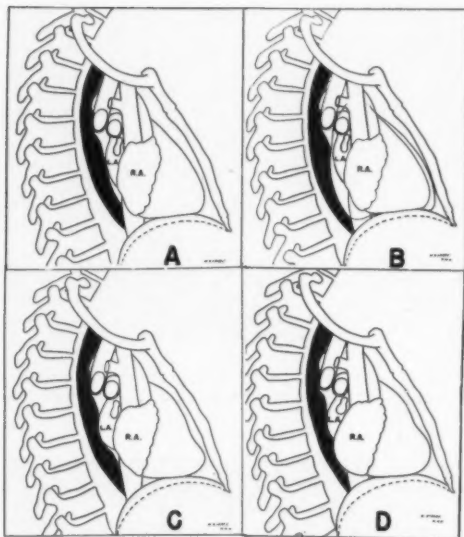


Fig. 13. Semidiagrammatic illustrations in right anterior oblique position showing the appearance of the esophagus under normal conditions (A), in pericardial effusion (B), in enlargement of the left atrium (mitral stenosis) (C), and in enlargement of the left and right atria (left and right-sided heart failure) (D). Note the "reversed 3" in left and right-sided failure and the smooth, continuous curve in pericardial effusion.

Let us now return to further consideration of the cardiohepatic angle. The junction of the right atrium and right ventricle is in the region of the cardiohepatic angle.

In right ventricular failure, the right ventricle dilates. This causes stretching of the tricuspid orifice, resulting in a relative tricuspid insufficiency. Because the right atrium now receives blood from both the regurgitant right ventricle and the venae cavae, it also becomes enlarged. Since the right ventricle extends from the cardiohepatic angle to the apex of the heart, dilatation of this chamber causes lateral displacement of its two extreme points. The lateral wall of the right atrium moves to the right. As a result, the cardiohepatic angle is pushed out and becomes obtuse (Fig. 11).

While the force of contractions of a weakened myocardium is usually diminished, pulsations, as seen under the fluoroscope, are always greater than in pericardial effusion. During fluoroscopy, pulsations synchronous with systole are usually seen in the superior vena cava and right diaphragm. These observations are best made with respiration suspended during deep inspiration.

Changes in intrathoracic pressure exert considerable influence on the size of the heart in ventricular failure. Thus, the heart will show a perceptible increase in size and a widening of the superior vena cava during

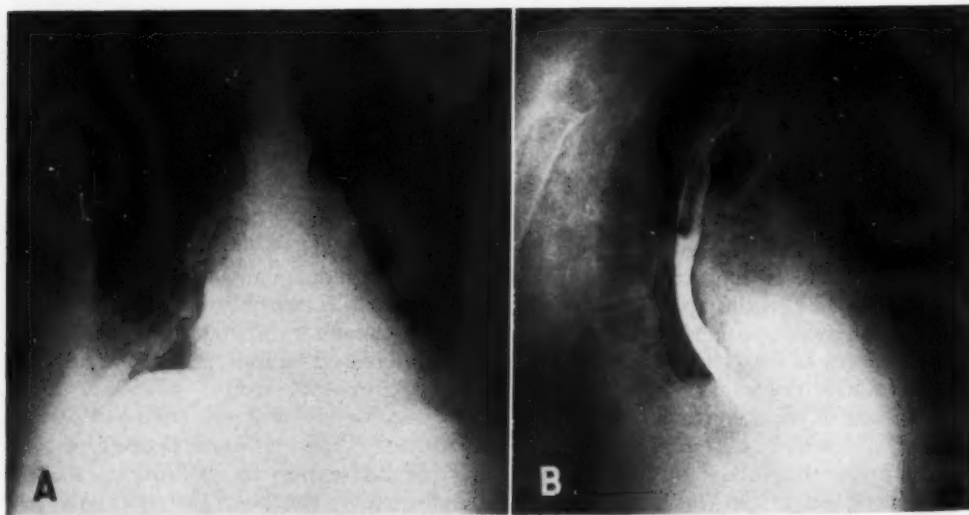


Fig. 14. Mitral stenosis. The enlarged left atrium produces one smooth, continuous curve as it displaces the esophagus.

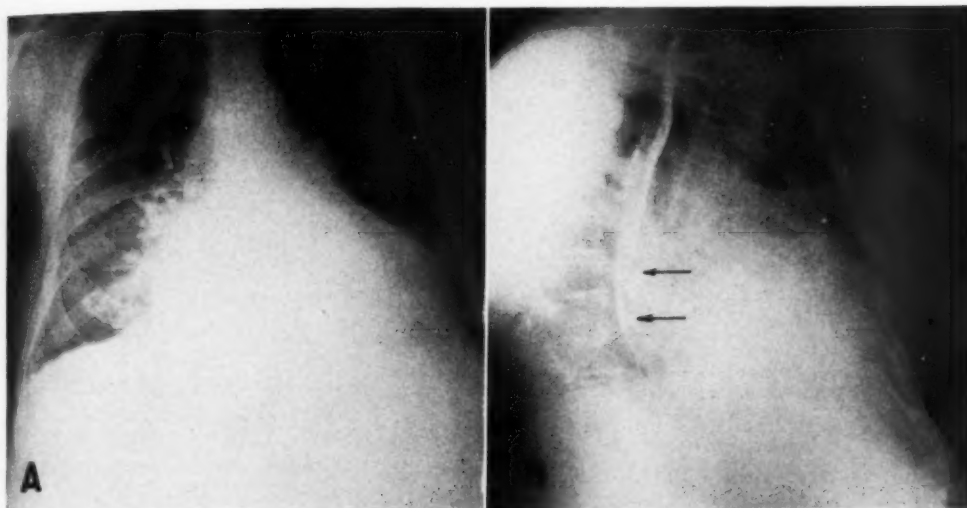


Fig. 15. Hypertensive heart disease with left and right ventricular failure.

- A. Note the obtuse cardiohepatic angle and the wide vascular pedicle.
 B. The barium-filled esophagus shows two slight pressure curves produced by enlargement of the left and right atria.

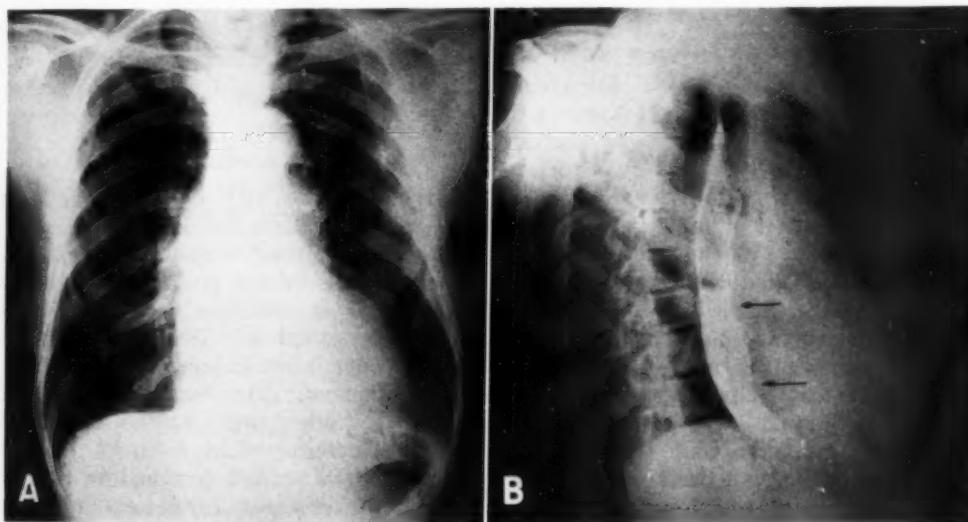


Fig. 16. Syphilitic and hypertensive heart disease with left and right ventricular failure.

- A. The heart is enlarged and the vascular pedicle widened.
 B. The esophagus shows the double curve ("reversed 3") typical of ventricular failure. The upper arrow indicates enlargement of the left atrium; the lower arrow indicates enlargement of the right atrium.

the Mueller test, and a definite diminution in size of these structures during the Valsalva test, owing, respectively, to increased and diminished venous return to the heart during these maneuvers (Fig. 12). On the

other hand, as Arendt has shown, the size and contour of the heart shadow in pericardial effusion are not influenced by such changes in intrathoracic pressure.

We have observed another sign which ap-

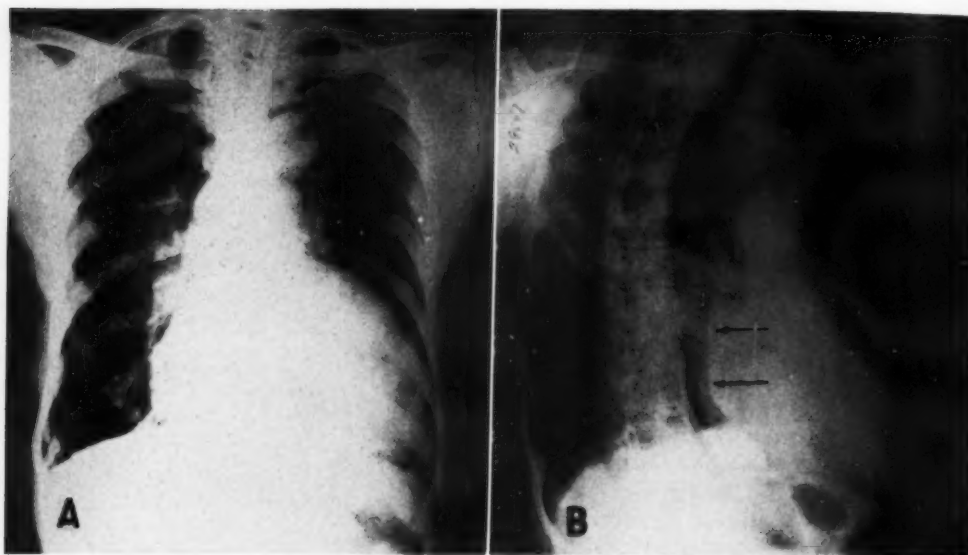


Fig. 17. Rheumatic heart disease (mitral and aortic valves) with left and right ventricular failure. Barium has already descended to the cardia but the esophagus is still well outlined by swallowed air. Note the double curve indicating enlargement of both left and right atria.

appears to be consistently reliable in detecting right-sided failure. This we have termed the "reversed three" sign. It is seen in the barium-filled esophagus. Right ventricular failure is most commonly associated with left-sided heart failure. As a result, there is dilatation of both right and left atria (Fig. 13). When examined in the right anterior oblique position, such patients will show a *double pressure curve* of the esophagus, somewhat resembling a reversed three (ε) (Figs. 14-16). The upper indentation is produced by the left atrium, the lower by the right atrium. (These deformities are, of course, always at a lower level than those normally produced by the aorta and pulmonary artery.²) In the presence of marked right-sided failure which has resulted in appreciable hepatic engorgement with consequent elevation of the right diaphragm, the lower curve of the esophagus, as seen in the right anterior oblique position, may appear to be below the diaphragm. The double curve is not

² The pressure deformity of the esophagus usually ascribed to the pulmonary artery has been shown by Evans (14) to be produced by the left bronchus interposed between the esophagus and pulmonary artery.

seen in mitral disease except in the presence of an associated right ventricular failure (Fig. 17).

SUMMARY

While the size and contour of the heart shadow in pericardial effusion may be simulated by any other type of heart disease, there are distinctive points of differentiation which should serve for identification. These are as follows: With early effusion, there is an increase in the length of the heart shadow. The cardiohepatic angle becomes more acute. As the size of the effusion increases, there is further increase in the length of the heart shadow, but the transverse diameter also becomes enlarged so that it may equal or exceed the length. The auriculoventricular junction on the left becomes obscured and, with large effusions, the cardiovascular junction on the right is obliterated. The vascular pedicle is usually small in comparison with the greatly enlarged heart shadow. Pulsations of the heart shadow are markedly diminished as observed fluoroscopically and, with larger effusions, there may be no

visible pulsations except in the region of the vascular pedicle.

Examination of the barium-filled esophagus shows a typical deformity which has a different appearance from that produced by an enlarged left atrium or an enlarged heart with right and left ventricular failure. The distinctive changes in the esophagus with pericardial effusion and with ventricular failure are presented as new diagnostic signs. Pericardial effusion produces a large, smooth, single pressure concavity on the esophagus, which resembles the deformity produced by an enlarged left atrium in mitral stenosis, but is at a lower esophageal level. A heart with right and left ventricular failure produces a double curve, like a reversed figure 3 (E). The acute cardiohepatic angle is an important typical diagnostic sign of pericardial effusion.

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SUMARIO

El Diagnóstico Roentgenológico del Derrame Pericardíaco, con Referencia Particular al Aspecto del Esófago Lleno de Bario y del Ángulo Cardiohepático

En el derrame pericardíaco incipiente, aumenta el largo de la sombra y el ángulo cardiohepático se agudiza. A medida que aumenta el tamaño del derrame, va aumentando la longitud de la sombra cardíaca, pero también se agranda el diámetro transversal, de modo que puede igualar o superar la longitud. Obscurece la unión auriculoventricular a la izquierda, y en los derrames grandes se oblitera la unión cardiovascular a la derecha. El pedículo vascular suele ser pequeño, comparado con la agrandadísima sombra cardíaca. A la observación roentgenoscópica, las pulsaciones de la sombra cardíaca se hallan notablemente disminuídas y, en los grandes derrames, acaso no sean visibles fuera de la región del pedículo vascular.

El examen del esófago lleno de bario muestra una deformidad típica de aspecto

distinto del producido por una aurícula izquierda hipertrofiada o por un corazón hipertrofiado con insuficiencia de los ventrículos derecho e izquierdo. Las alteraciones distintivas observadas en el esófago en el derrame pericardíaco y en la insuficiencia ventricular son presentadas como nuevos signos diacríticos. El derrame pericardíaco produce por compresión una gran concavidad lisa y aislada sobre el esófago, parecida a la producida por una aurícula izquierda hipertrofiada en la estenosis mitral, pero queda a un nivel esofágico más bajo. Un corazón con insuficiencia biventricular produce una doble curva, semejante a un número 3 virado a la derecha (E). La agudización del ángulo cardiohepático constituye un importante y típico signo diagnóstico del derrame pericardíaco.

Nitrogen Mustard as an Adjunct to Radiation in the Management of Bronchogenic Cancer¹

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IT is generally agreed that pulmonary resection offers the patient with bronchogenic carcinoma his best chance for cure. Unfortunately, most cases are inoperable when first seen. Of the 400 patients with bronchogenic carcinoma seen at the Veterans Administration Hospital in the Bronx (N. Y.) in the past four years, 90 per cent came too late for surgery. At the Hines Veterans Hospital, 95.4 per cent of 1,057 such patients admitted from 1937 to 1947 were already beyond any attempt at salvage by surgical resection (1). This distressing picture is reflected in other hospitals and clinics. It may be estimated that in 1949 there were in this country about 28,000 new patients with bronchial cancer, compared to 10,000 in 1939 (34).

Unless treated by irradiation, inoperable bronchogenic carcinoma runs its lethal course rapidly and inexorably, complicated by distressing signs and symptoms, both local and systemic. Of 584 non-irradiated inoperable patients, not one survived more than one year after the onset of the disease, according to the combined reports of Leddy and Moersch (18) at the Mayo Clinic, Widmann (31) at the Pennsylvania General Hospital, and Ariel *et al.* (1) at the Hines Veterans Hospital.

On the other hand, our own experience with the roentgen treatment of 605 inoperable cases in the last fifteen years has demonstrated that, when radiation therapy was feasible, effective relief from intractable local symptoms was often possible. Indeed, prolongation of useful life for many months, and even years, was sometimes

accomplished, particularly when the patient's physical condition was such that cancerocidal doses (5,000 to 6,000 r) could be approached. An occasional rare cure may be achieved. These observations are supported by the experience of others in a group of 508 roentgen-treated cases reported in the literature (6, 18, 28, 31).

It is not possible, however, to give to every inoperable patient the benefits which irradiation can offer. At intervals in the course of the disease irradiation may seem to be ineffective or, for various reasons, even unfeasible. An effective adjunct to radiotherapy would therefore, appear, to be most desirable during these periods. The object of this paper is to present the results of our investigation of nitrogen mustard or HN2,—methyl-bis (beta chloroethyl) amine hydrochloride—employed in this role.⁴

RATIONALE OF NITROGEN MUSTARD TREATMENT

The early investigations of Gilman (11), Goodman (12), Jacobson (13), and Karnofsky (14 and 15), and their co-workers, with nitrogen mustard in human lymphomas, excited our interest in investigating its role as an adjunct to radiotherapy in a variety of malignant disorders. The study was begun in the Radiation Clinic in January 1947, in collaboration with the Committee on Growth of the National Research Council. Bronchogenic carcinomas were included because of scattered reports of clinical benefit by other investigators (33). In an earlier communication (21)

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⁴ Nitrogen mustard (mustargen) supplied through courtesy of Merck & Co., Rahway, N. J.

we reported our experience with nitrogen mustard as an adjunct to radiation in a group of 87 patients with a variety of neoplastic diseases, including 16 subjects with inoperable bronchogenic carcinoma. Nine of the 16 cases showed a favorable response to the chemotherapeutic agent.

Nitrogen mustard is a systemic toxin with special selectivity for the blood-forming organs, the gastro-intestinal tract, and actively proliferating tissues. Its physiological action on tissues is remarkably rapid, and its physical half life, or the time required for conversion into the highly reactive imine form, is only 90 seconds. One might therefore expect the lung to be the first organ to receive the full impact of the agent after intravenous injection. The pulmonary tissue is probably the only one exposed to the full dose, although some of the material may already have reacted with constituents of the blood. Recent studies on mice by Seligman, Friedman, and Rutenburg (24) with radioactive HN2 tagged with I^{131} have demonstrated the highest concentration in the lung, blood, lymph nodes, spleen, and kidney. The lung was the only tissue in which radioactivity persisted after injection.

There is a remarkable paucity of histologic findings to explain the clinical changes observed. The minimal changes, however, that have been reported by Spitz (27), Lynch, Ware, and Gaensler (19), and Gaensler *et al.* (10) are similar to those seen after small doses of ionizing radiation. In no instance was the tumor entirely eradicated. Even in small amounts, however, HN2 is highly cytotoxic and nucleotoxic, powerfully inhibiting a variety of cellular enzymes and inhibiting vital metabolic processes such as cellular respiration.

CLINICAL MATERIAL

Since January 1947, 150 patients with inoperable bronchogenic carcinoma have been accepted for treatment in the Radiation Clinic of the Veterans Administration Hospital in the Bronx. Forty of these patients received HN2 as an adjunct to roentgen therapy when radiation was un-

feasible or no longer effective because of (a) radioresistance, (b) severe radiation sickness, (c) exhaustion of skin portals, (d) intractable systemic symptoms, (e) acute mediastinal compression, and (f) far advanced disease with generalized metastases. The 16 cases mentioned in our preliminary communication are included in the present report. With a single exception, the diagnosis of bronchogenic carcinoma was histologically proved. In that instance there was overwhelming clinical, radiological, and bronchoscopic evidence of the disease. The histologic types were as follows: epidermoid carcinoma, 8; anaplastic carcinoma, 23; mucous-gland carcinoma, 4; and unclassified carcinoma, 5. Among the anaplastic tumors were 4 of the "oat-cell" variety.

TECHNIC

Nitrogen mustard was given intravenously in doses of 0.1 mg. per kilogram of body weight, once daily for four consecutive days. This constituted a single course which was repeated, if indicated, but only after an interval of four weeks or longer to permit complete recovery of the bone marrow. No patient was given more than two courses. In no case were roentgen therapy and nitrogen mustard employed simultaneously.

Immediately before treatment, 10 c.c. of sterile normal saline was introduced into a glass vial containing 10 mg. of the crystalline salt, thus creating a solution of 1.0 mg. of HN2 per cubic centimeter of solution. The appropriate dose was at once withdrawn and injected into the vein, or into the rubber tubing of a running infusion of normal saline. The latter technic is probably more satisfactory and minimizes the danger of a chemical phlebitis. Local extravasation of the drug will result in necrosis of tissue.

Gastro-intestinal symptoms such as nausea and vomiting were encountered in the majority of the cases after the first dose, beginning from one to eight hours after injection. These complaints were less common following subsequent injections and

appeared to be modified by the use of hypnotics. The hemopoietic changes, particularly leukopenia and thrombocytopenia were not usually serious, but frequent blood studies are a desirable precaution. Marked bone marrow depression before treatment must be regarded as a contraindication to HN2 therapy. Other toxic reactions, local and systemic, have been reported in detail in earlier communications (21, 23).

RESULTS

A favorable response to nitrogen mustard therapy was observed in 30 of the 40 patients (75 per cent), in the form of a remission period averaging three and a half weeks. In 10 patients the results were poor or negligible. In reaching these conclusions the following criteria were used:

(1) *Subjective Response:* Relief from systemic symptoms such as fever, night sweats, weakness, and anorexia, and from local symptoms such as intractable chest pain, cough, and dyspnea. A favorable *subjective* result was achieved in 30 cases for periods varying from one week to seventeen weeks. Statistical analyses can hardly reflect the dramatic clinical improvement in some patients, grateful for even a brief respite from insufferable discomfort.

(2) *Objective Response:* Improvement in the signs of superior vena cava compression syndrome (Fig. 4A and B), gain in weight, resorption of pleural fluid, decrease in pulmonary lesions, disappearance of atelectasis, and regression of obstructive pneumonitis. A favorable *objective* result was noted in 19 of the 30 cases with a favorable subjective response. Immediate *radiographic* evidence of improvement, however, was encountered in only 4 instances (Figs. 4C and D, 5A and B, 6A and B). In some instances progression and metastases were noted even in the face of definite clinical improvement (Fig. 1A and B).

(3) *Degree of Rehabilitation:* Improvement of the patient to the point where a course of radiotherapy could be initiated, resumed, or completed; discharge from hospital to home, maximum hospitalization

benefit having been achieved. In 12 of the 30 patients responding favorably, improvement in severe systemic symptoms was of such a degree that definitive x-ray therapy could be initiated. Five patients responded so well that they were discharged to their homes.

Patients with the anaplastic type of lesion showed the highest percentage of favorable response (Table I). The re-

TABLE I: RESPONSE IN RELATION TO HISTOLOGY

Histologic Types	Number of Cases	Result	
		Favorable	Unfavorable
Epidermoid carcinoma	8	4	4
Anaplastic carcinoma	23	20	3
Mucous-gland carcinoma	4	2	2
Unclassified carcinoma	5	5	0

sponse in relation to the six primary indications for adjunct HN2 treatment are shown in Table II.

TABLE II: RESULTS ACCORDING TO INDICATIONS FOR TREATMENT

Indications	No. of Cases	Response to HN2—	
		Favorable	Poor
(a) Radioresistance	7	2	5
(b) Severe radiation sickness	2	2	0
(c) Exhaustion of skin portals	1	1	0
(d) Intractable systemic symptoms	15	12	3
(e) Acute mediastinal compression	9	7	2
(f) Very far advanced disease	6	6	0
Totals	40	30	10

(a) There were seven radioresistant subjects who failed to respond to an initial course of radiotherapy and therefore received HN2. Two of these patients reacted very well to the chemotherapeutic agent.

CASE 1. A 63-year-old grocer with a Pancoast tumor experienced the type of unrelenting pain in the left shoulder girdle, radiating to the arm, which is so characteristic of this variety of bronchial carcinoma. In our experience these tumors are generally radioresistant. Although radiation was being rapidly delivered to the lesion and a level of 1,600 r

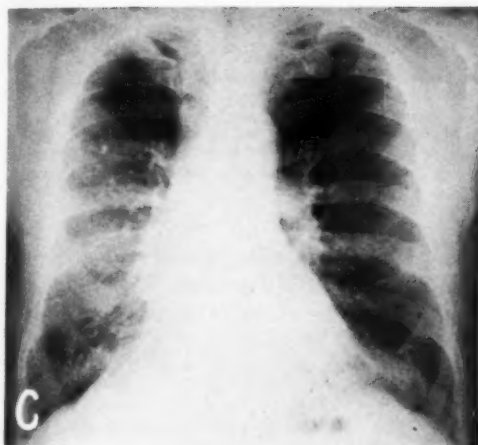
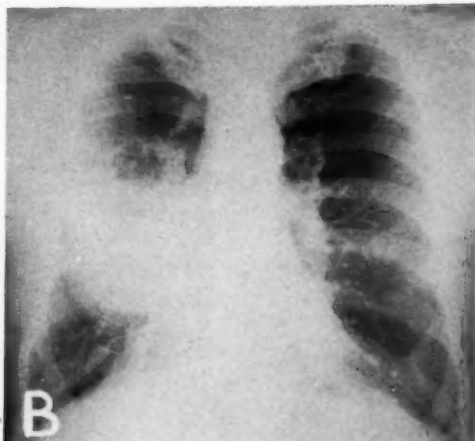
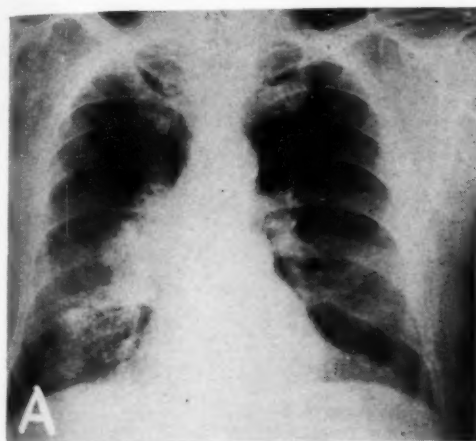


Fig. 1. Case 3. A. Bronchogenic carcinoma, with right mediastinal mass. Radiotherapy started (300 r depth dose). Intractable radiation sickness precluded further radiotherapy. HN2 was administered.

B. After HN2, there was marked subjective improvement, but the roentgenogram reveals progressive disease. One week later, the patient was able to tolerate more radiation.

C. After x-ray therapy (1,500 r depth dose). Marked improvement radiographically and subjectively. The patient was able to go home and remission lasted nearly four months.

had been attained, the pain appeared to be growing steadily more severe. A course of HN2 produced immediate relief.

CASE 2: A 48-year-old auto mechanic was refractory to 4,500 r (depth dose) administered for severe chest pain secondary to pleural invasion by bronchial carcinoma. A single course of HN2 produced striking relief from pain and improvement in appetite and well-being. The patient was able to return home and to resume normal activity for a period of eight weeks.

(b) HN2 was employed in 2 subjects experiencing uncontrollable radiation sickness which interrupted a course of prescribed radiotherapy. Both patients enjoyed a favorable response. Radiation sickness as a complication has become uncommon in our Clinic since the introduc-

tion of desoxycorticosterone acetate (8) for its control.

CASE 3: A 53-year-old bedridden police officer with a large endobronchial tumor and enlarged mediastinal nodes received radiation to the mediastinum for the relief of pain, dyspnea, and obstructive pneumonitis (Fig. 1A). He became nauseated and vomited repeatedly after only 300 r (depth dose) had been delivered. In spite of medication, the radiation illness appeared intractable, and a course of HN2 was administered for management of the neoplasm. Dyspnea improved, fever and night sweats diminished, and the patient became ambulant. Radiotherapy was immediately resumed, because of radiographic evidence of extension of the tumor (Fig. 1B), a total of 1,500 r (depth dose) being delivered to the chest without further difficulty. Clinical and radiographic improvement followed promptly (Fig. 1C). The patient was discharged to his home and remained well for nearly four months.

(c) The exhaustion of available skin portals as a result of marked radiation reactions is occasionally an obstacle to completion of effective radiotherapy. One such case was treated with HN2. Precisional cross-fire radiation through multiple portals (7, 22), rotation therapy, and super-

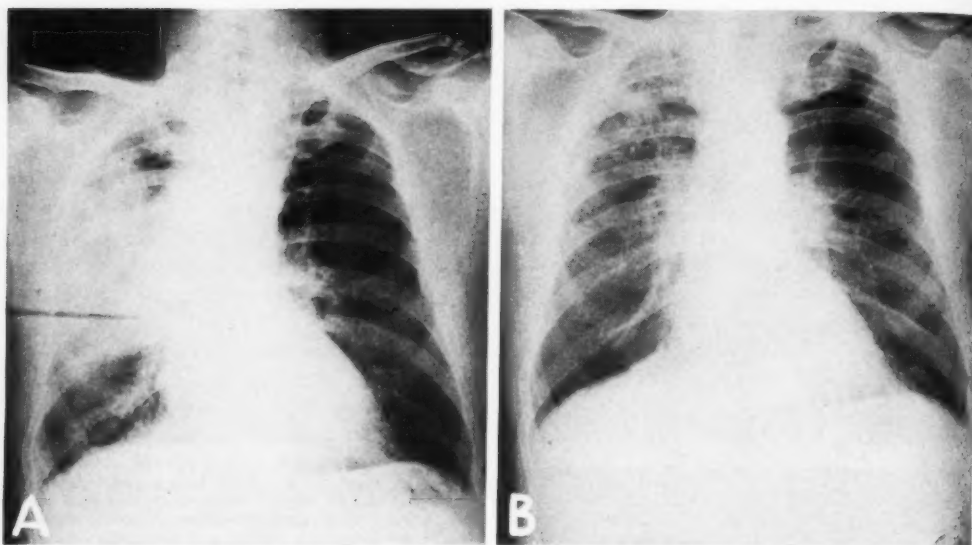


Fig. 2. Case 5. A. Mediastinal nodes and obstructive pneumonitis due to bronchogenic carcinoma, associated with intractable chest pain, cough, and dyspnea.

B. Almost complete disappearance of tumor and obstructive pneumonitis after 6,000 r depth dose. Clinical remission lasted six months. A repeat course of radiation was then made possible only with the aid of nitrogen mustard therapy.

voltage radiation promise to minimize this complication.

CASE 4: A 40-year-old veteran received 2,500 r (depth dose) to the chest for relief of superior vena cava compression syndrome secondary to anaplastic bronchogenic carcinoma. Marked improvement was achieved, and the patient remained well for more than nine months. When his complaints recurred, the mediastinal skin portals showed a residual radiation effect too severe to permit further irradiation. The administration of HN2 was followed by remission of pain and dyspnea and regression of venous engorgement of the neck, lasting three and a half weeks. At the end of this period an experimental lead grid was devised to minimize the residual skin reaction. X-ray therapy was resumed and at the time of this report is approaching a cancerocidal dose, with much clinical benefit.

(d) In 15 of the 40 patients, the neoplastic disease was responsible, at variable intervals, for symptoms and signs of a systemic nature so severe as to preclude roentgen-ray therapy. The clinical picture at these intervals included extreme weakness, fever, night sweats, anorexia, and weight loss. Nine of the patients were so gravely ill that even transportation to the radiotherapy apparatus was fraught with

danger. A favorable clinical response was achieved with HN2 in 12 of this group, and definitive x-ray therapy became feasible in 6 instances.

CASE 5: A 64-year-old house painter received 6,000 r (depth dose) to the mediastinum for severe chest pain and intractable cough secondary to mediastinal extension of an anaplastic bronchogenic carcinoma (Fig. 2A). A remarkable clinical and radiographic response was observed (Fig. 2B), and the patient enjoyed a remission of six months with normal activity in a veterans' rest camp in the Adirondacks. He returned to the hospital complaining of abdominal pain and distention, jaundice, constipation, malaise, and weight loss of short duration. This clinical syndrome appeared to be the expression of metastatic neoplastic disease in the retroperitoneal nodes and abdominal organs. So seriously ill was the patient that even palliative irradiation seemed unfeasible. However, his systemic symptoms responded so readily to a single course of HN2 that we were encouraged to institute a course of radiation therapy to the abdomen. The response was again most gratifying, with relief of pain, regression of tumor masses, and even disappearance of jaundice for a month. This remission period was followed by the advent of intracranial metastasis and progressing abdominal cancer.

(e) Patients with compression of the

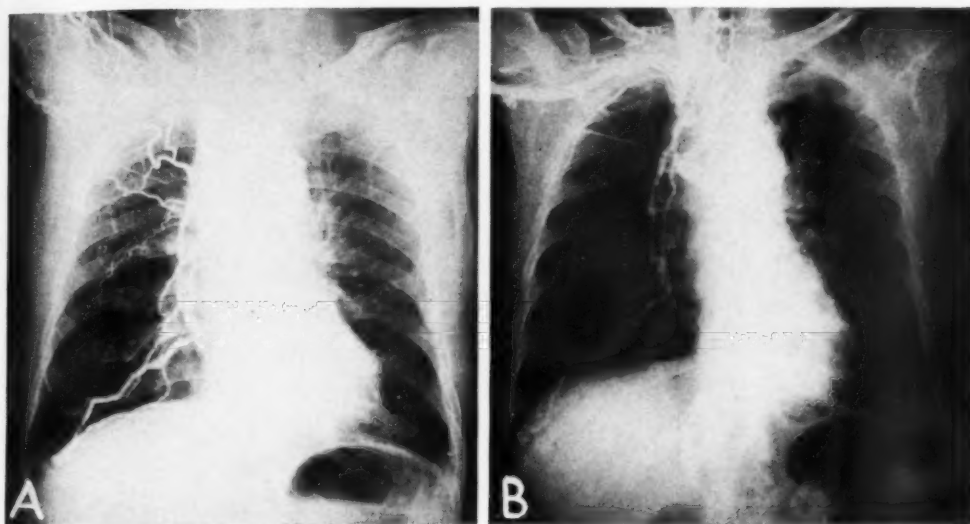


Fig. 3. Case 6. A. Angiogram before HN2 therapy. Note block of the superior vena cava, with marked collateral circulation. The patient presented the clinical syndrome of superior mediastinal compression due to bronchial cancer.

B. Angiogram after HN2 therapy, showing no significant change despite marked clinical improvement. Remission for seven weeks at home.

superior mediastinal structures due to bronchial carcinoma sooner or later will be in desperate need of relief from strangulation symptoms. Prior to January 1947, those patients who could be safely transported to the deep roentgen-ray apparatus generally benefited from daily fractional doses judiciously administered. Only terminal care could be offered those too gravely ill for transportation.

After January 1947, when HN2 was introduced, 9 patients with acute severe mediastinal compression were encountered, much too ill and dyspneic for transportation and too severely orthopneic for administration of deep x-ray therapy. Nitrogen mustard was given to all individuals in this group and 7 obtained immediate remissions. The clinical benefits of HN2 were often apparent before the course of four treatments was completed.

CASE 6: A 55-year-old veteran was admitted with the full-blown syndrome of superior vena cava compression secondary to bronchogenic carcinoma (Fig. 3A). The intensity of dyspnea, orthopnea, cyanosis, and swelling of the head and neck was most alarming. A course of HN2 produced complete relief

of strangulation symptoms and signs, with increase in weight, strength, and appetite. The patient was soon discharged from the hospital and remained well, at home, for seven weeks.

It is of interest that, in spite of the excellent clinical response, serial angiocardiographic studies, made expressly for this purpose, showed little or no change in the obstructing neoplasm after nitrogen mustard therapy (Fig. 3B).

CASE 7. A 55-year-old veteran with classical signs of mediastinal strangulation secondary to oat-cell (anaplastic) bronchial carcinoma was almost completely relieved of dyspnea, orthopnea, edema of the face, cough, and chest pain after the first course of HN2. This remission lasted more than a month. Impressive objective evidence of favorable response was obtained in the form of infra-red photographs (Fig. 4A and B) and roentgenograms (Fig. 4C and D). The patient's difficulties recurred with greater intensity, but a second course of nitrogen mustard was of no avail.

(f) There were 6 patients with very far advanced pulmonary disease and generalized metastases in whom there was observed a prompt clinical response to HN2 that was quite unusual in some instances. The period of rehabilitation lasted from two weeks to two months, averaging 21 days.

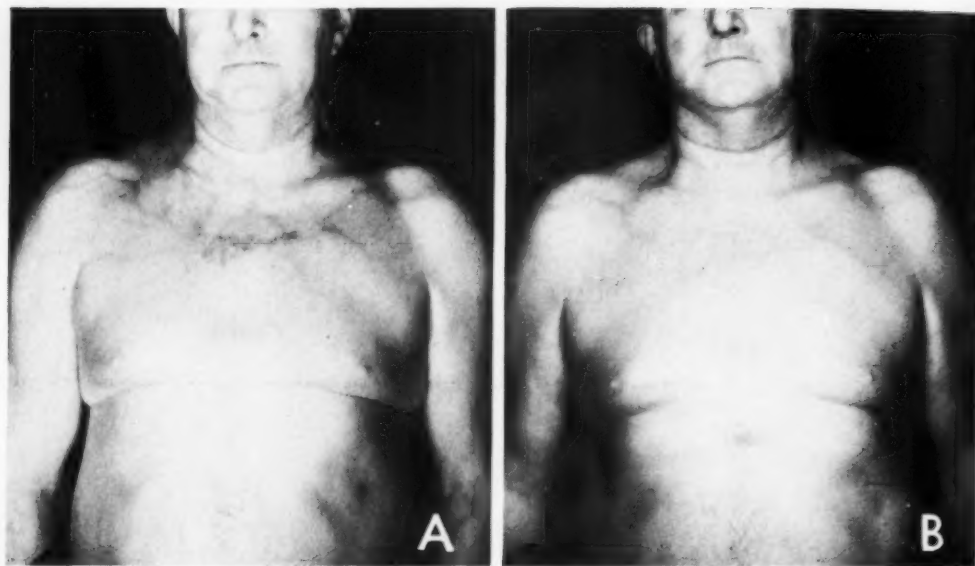
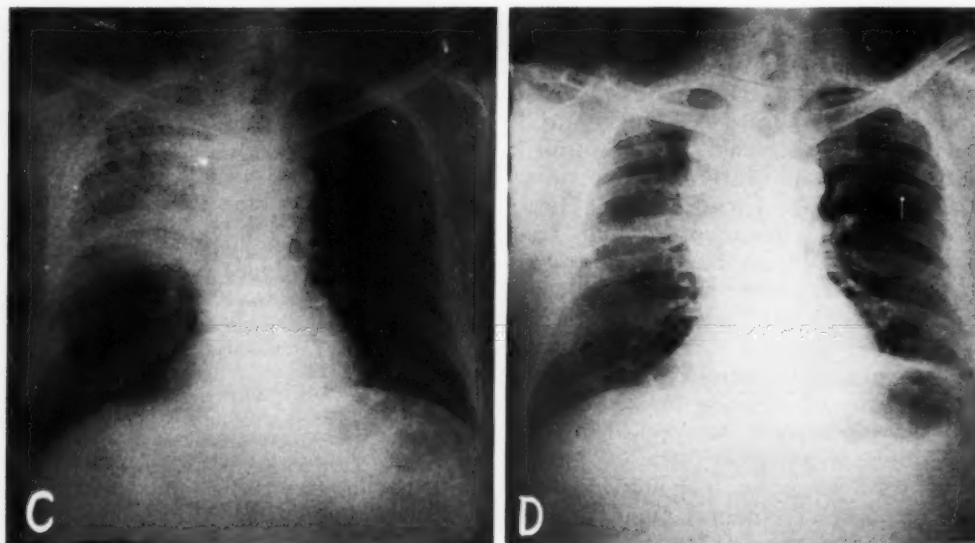


Fig. 4. Case 7. A. Infra-red photograph of a 55-year-old veteran with severe compression of superior vena cava by mediastinal tumor of bronchogenic origin. Note enormously dilated venous channels of chest wall. B. Infra-red photograph obtained ten days after nitrogen mustard therapy, showing regression of dilated venous channels. This was associated with striking symptomatic benefit lasting one month.



C. Roentgenogram prior to first course of nitrogen mustard therapy. Note mediastinal mass and obstructive pneumonitis of right upper lobe.

D. Roentgenogram following mustard therapy. Note regression of pneumonitis. The mediastinal mass persists, however, despite clinical remission.

The infra-red photographs (A and B) appeared previously in the *American Journal of Roentgenology* and are reproduced here by permission.

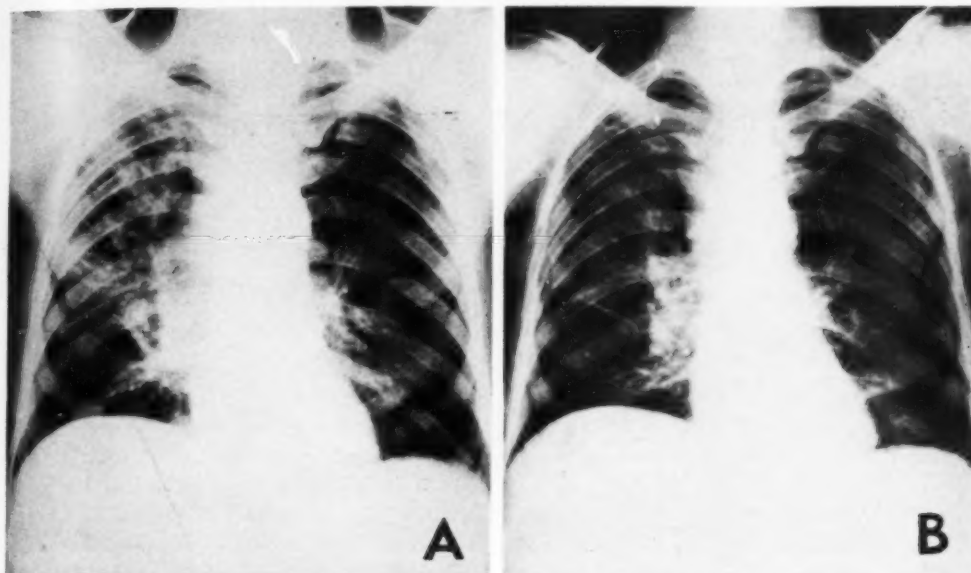


Figure 5. Case 8. A. May 10, 1948. Obstructive pneumonitis of right upper lobe, with mediastinal and hilar lymphadenopathy in a 49-year-old veteran with bronchial cancer. Superior vena cava compression and massive hepatomegaly. Patient extremely ill, almost "pre-terminal."

B. June 18, 1948, one month after nitrogen mustard therapy. Clearing of obstructive pneumonitis and diminution in lymph node involvement. Striking clinical improvement for one month.

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CASE 8: A 49-year-old Negro soldier was prostrated with far advanced anaplastic bronchial carcinoma associated with massive metastases in the liver, which distended the abdomen enormously. Dyspnea and orthopnea secondary to obstructive pneumonitis and compressing mediastinal nodes were most distressing (Fig. 5A). Although the case was regarded as "pre-terminal," nitrogen mustard was administered and a striking change was observed at the end of the four-day course. The liver receded fully 5 cm., the dyspnea and orthopnea were relieved through clearing of the pneumonitis (Fig. 5B), and the patient was able to get up and about without aid. He was comfortable and reasonably well till one month later, when his complaints recurred and intracranial metastases brought about his demise.

CASE 9: A 40-year-old veteran was found to be suffering from marked dyspnea, chest pain, fever, chills, anorexia, and marked weight loss. This was associated with atelectasis of the right lower lobe, metastatic deposits of anaplastic bronchogenic carcinoma in both lung fields, and extension of cancer to the mediastinal nodes (Fig. 6A). The patient was much too ill for anything but pre-terminal care. After a single course of HN2, there was regression of atelectasis, associated with remarkable clinical improvement, gain in strength and appetite, and relief of fever and dyspnea (Fig. 6B). This period of remission lasted two weeks. It is strange, however,

that, while the right lung field cleared, enlargement of metastatic deposits in the left lung was observed during the period of clinical remission.

No statistically valid conclusions regarding prolongation of survival time through the use of nitrogen mustard alone may be drawn from this series of cases. A few individuals treated in a pre-terminal state did gain a few weeks of comfortable life. In the opinion of other investigators (Table III) survival time does not appear to be appreciably prolonged.

DISCUSSION AND CONCLUSIONS

1. In this investigation, 40 patients with inoperable bronchogenic carcinoma received nitrogen mustard as a systemic adjunct to roentgen therapy when, in the opinion of the therapeutic radiologist, radiation appeared to be no longer feasible or effective. The specific indications for the employment of the drug have been described and illustrative case records cited.

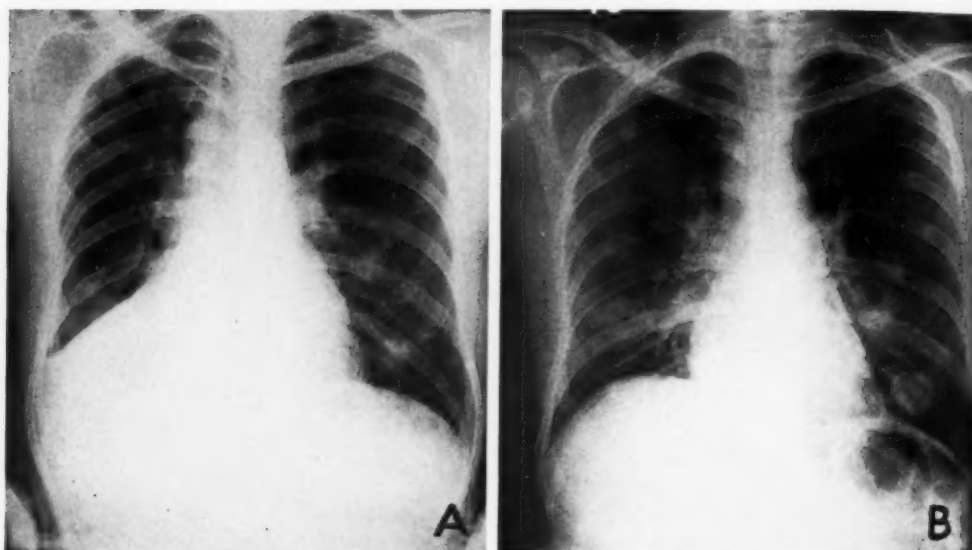


Figure 6. Case 9. A. Bronchial cancer causing atelectasis of right lower lobe, in a veteran aged 40 years, with metastatic deposits in both lung fields and in the mediastinal nodes. Marked dyspnea, pain, fever, chills and anorexia.

B. May 19, 1947, after HN2 therapy. Regression of atelectasis, associated with remarkable clinical improvement. Gain in appetite and strength and relief from fever and dyspnea. Note, however, enlargement of metastatic parenchymal deposits.

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TABLE III.: COLLECTED CASES TREATED WITH NITROGEN MUSTARD

Investigators	Total No. Cases	Favorable Response
1. Ariel, I. M., and Kanter, L. (2)	26	8
2. Ben-Asher, S. (3)	11	2
3. Bierman, H. R., <i>et al.</i> (4)	5	0
4. Boyland, E., <i>et al.</i> (5)	41	25
5. Faloan, W. W., and Gorham, L. W. (9)	5	0
6. Karnofsky, D. A., Abelman, W. H., Craver, L. F., and Burchenal, J. H. (14)	35	26
7. Kent, L., and Reh, E. P. (16)	19	4
8. Kurnick, N. B., Paley, K. R., Fieber, M. H., and Adler, D. K. (17)	10	2
9. Lynch, J. P., Ware, P. F., and Gaensler, E. A. (19)	60	41
10. Shullenberger, C. C., Watkins, C. H., and Kierland, R. R. (25)	3	1
11. Skinner, E. F., Carr, D., and Denman, W. E. (26)	25	18
12. Videback, A. (29)	6	1
13. Wawro, N. W. (30)	4	4
14. Wintrobe, M. M., and Huguley, C. M., Jr. (32)	4	2
	254	134

2. Of the 40 patients, 30 enjoyed remissions of severe subjective symptoms and 19 experienced objective improvement as well. The remissions ranged from one to seventeen weeks, with an average of three and a half weeks. After a single course of the chemotherapeutic agent, it became possible to initiate effective radiotherapy in several patients apparently too seriously ill for any form of definitive treatment.

3. An exhaustive search of the literature has revealed a collective total of 254 cases treated with HN2 by 14 other investigative groups (Table III). In 134 of these cases (52.8 per cent) a favorable response was observed.

4. In our opinion, nitrogen mustard should never be employed as a substitute for radiotherapy in the presence of relatively localized inoperable bronchial cancer. Such patients should be given the benefits which local cancerocidal radiation can offer: longer remissions, prolongation of useful life for months or even years, and

a rare chance for cure. These conclusions are based principally upon (a) our control experience with 605 roentgen-treated patients, (b) a review of all mustard-treated cases thus far reported, and (c) 508 roentgen-treated cases from the literature (6, 18, 28, 31).

Leddy and Moersch, for example, indicated that 25 of 125 patients treated with deep roentgen-ray therapy lived from one to twelve years. Craver (6) reported a 5-year survival rate of 3.8 per cent in his series of roentgen-treated patients. Indeed, rapid advances now being made in new radiation technics, radiobiology, and mega-voltage engineering give promise of much more effective irradiation of deep-seated tumors.

5. In conclusion, we believe that nitrogen mustard, despite its limitations, will provide the therapeutic radiologist with a truly valuable adjunct to radiation in the management of inoperable bronchogenic cancer.

Acknowledgments: The authors wish to express their appreciation for the clinical services contributed by the Chest Sections of the Medical and Surgical Divisions. They are grateful, also, to the Medical Illustration Service for the quality of the illustrative material.

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SUMARIO

La Mostaza Nitrogenada como Coadyuvante de la Irradiación en la Asistencia del Cáncer Broncogénico

Cuarenta enfermos con carcinoma broncogénico inoperable recibieron mostaza nitrogenada como coadyuvante general de la roentgenoterapia cuando la última no parecía ser ya más factible o efectiva. Las indicaciones específicas para el empleo de dicha mostaza fueron las siguientes: (a) radiorresistencia de la lesión; (b) grave radiopatía; (c) agotamiento de las puertas cutáneas; (d) síntomas orgánicos intratables; (e) compresión mediastínica aguda; y (f) enfermedad avanzadísima. Presentanse casos típicos de dichos estados.

En 30 de los 40 pacientes, el tratamiento con mostaza nitrogenada fué seguido de remisión de graves síntomas subjetivos, y en 19 de ellos se notó igualmente mejoría objetiva. Los períodos de remisión variaron de una a diecisiete semanas, promediando tres semanas y media. Después

de una sola tanda de mostaza nitrogenada, fué posible iniciar una roentgenoterapia efectiva en varios sujetos que previamente habían sido considerado demasiado enfermos para toda forma de tratamiento definitivo.

La mostaza nitrogenada no se recomienda como substituto de la roentgenoterapia en presencia de cáncer bronquial inoperable y relativamente localizado. Esos enfermos tienen derecho a los beneficios brindados por la irradiación cancerocida local, o sean: remisiones más largas, prolongación de la vida útil por meses y posiblemente años, y hasta una probabilidad rara de curación. Sin embargo, esa mostaza sí aporta un valioso coadyuvante de la irradiación cuando ésta se ha vuelto ineficaz o está contraindicada por las razones expresadas.



Cerebellopontine Angle Tumors: Their Roentgenologic Manifestations¹

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TWO YEARS AGO we recorded our findings in 122 patients with proved acoustic nerve tumors operated upon in the Hospital of the University of Pennsylvania, the Graduate Hospital of the University of Pennsylvania, and the Temple University Hospital (5). At that time we concerned ourselves only with eighth nerve tumors.

of these hospitals, Dr. Francis C. Grant and Dr. Robert A. Groff.

Our present series comprises 183 patients with angle tumors operated upon in the two hospitals. Of this group, 134 had eighth nerve tumors, 19 had meningiomas, 16 gliomas, 7 cholesteatomas of the cerebellopontine angle, 3 hemangioblastomas, and there were single cases of metastatic

TABLE I: CEREBELLOPONTINE ANGLE TUMORS

	Number of Cases	Percentage
Eighth Nerve Tumors	134	73.0
Acoustic Neurinomas..... 126		
Neurofibromas..... 6		
Mixture of Neurinoma and Meningioma..... 2		
Meningiomas	19	10.4
Gliomas	16	9.0
Astrocytomas..... 9		
Glioblastoma Multiforme..... 4		
Spongioblastoma Polare..... 1		
Spongioblastoma Multiforme..... 1		
Medulloblastoma..... 1		
Cholesteatomas	7	4.0
Hemangioblastomas	3	1.6
Metastatic Carcinoma	1	0.5
Hemorrhagic Cyst	1	0.5
Chondrosarcoma	1	0.5
Chondromyxoma	1	0.5
TOTAL CEREBELLOPONTINE ANGLE TUMORS	183	100.0

The present report will bring our experiences with acoustic nerve tumors in the Hospitals of the University of Pennsylvania up to date. In addition, we have reviewed the records of all other patients operated upon for cerebellopontine angle tumor syndromes who proved to have neoplasms other than acoustic neuromas. The roentgen findings in these cases, also, will be recorded.

The data for this report were taken from the records of the Neurosurgical Services of the Hospital of the University and the Graduate Hospital of the University of Pennsylvania, made available to us through the kindness of the neurosurgeons

carcinoma, encapsulated hemorrhage, chondrosarcoma, and chondromyxoma (Table I).

Having reviewed the anatomy of the cerebellopontine angle only two years ago (5), we will not repeat the description, nor will the roentgen anatomy of the petrous pyramid be summarized again. Suffice it to say that petrosal pyramids and internal acoustic meatuses vary remarkably from patient to patient, and, indeed, on both sides of the same individual. Familiarity with these normal variations is of paramount importance if false positive reports are to be avoided. For these valuable observations, the reader is referred to the studies

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of Ebenius (2) and Camp and Cilley (1) previously reviewed by us in detail.

EIGHTH NERVE TUMORS

Of the 134 true tumors of the eighth nerve, constituting 73 per cent of our entire series, the vast majority proved to be acoustic neurinomas (93 per cent); the rest were acoustic neurofibromas of the von Recklinghausen type.

The reader is referred to our previous report for a detailed account of the pathology of eighth nerve tumors. To review here briefly: In neurinomas, the nerve fibers are demonstrated only in the capsule of the tumor, while in the neurofibromas of von Recklinghausen the nerve fibers penetrate the tumor. Whereas the former are usually single lesions, von Recklinghausen's tumors often prove to be bilateral and familial. Not infrequently the latter are associated with neurofibromas involving other cranial or peripheral nerves and, in rare instances, with meningiomas.

Eighth nerve tumors usually follow a characteristic progressive pattern of neurologic signs and symptoms. In most instances, one can consider their pathologic physiology as being divided into three stages (4). In the first stage, the tumor and its symptoms are limited to the fifth, seventh, and eighth nerves. As the tumor grows, the second stage of the syndrome ensues, with ataxia of cerebellar origin. Finally, in the third stage, the clinical manifestations of increased intracranial pressure become evident.

Since the publication in 1917 of Cushing's classic monograph on acoustic nerve tumors, the literature has repeatedly emphasized his chronology of symptoms (5). Indeed, some consider it almost infallible (6). According to Cushing, the earliest symptoms are auditory and labyrinthine. Tinnitus in the affected ear, followed by gradually progressing deafness, usually ushers in the disease. For a long time the symptoms are confined to the functions of the eighth nerve. As the tumor grows, headache develops, particularly occipital and occipitofrontal. With

pressure upon the cerebellum, pons, and medulla, a mild degree of unsteadiness occurs, gradually assuming the characteristics of cerebellar inco-ordination and instability. Usually, when the tumor has progressed thus far, evidence of adjacent cranial nerve involvement becomes manifest. As the fifth nerve is affected, patients complain of trigeminal neuralgia or numbness of the face. Facial paresis, paralysis, or even spasm develops as the seventh nerve is included in the growth.

When the tumors have attained sufficient size to interfere with the aqueduct of Sylvius, the signs of increased intracranial pressure develop; the headaches become worse, and vomiting, ataxia, failing vision, dysarthria and dysphagia follow soon thereafter. Death commonly is the result of a cerebellar crisis.

The differentiation of eighth nerve tumors from other lesions causing cerebello-pontine angle symptoms is oftentimes extremely difficult or impossible. Whereas the clinical history and roentgenograms help considerably, one occasionally obtains valuable information from an evaluation of the cranial nerves.

Grant and Spitz (4) studied the above mentioned phase of the problem carefully in 50 patients some years ago. They found that the first cranial nerve was rarely involved; the second cranial nerve showed changes (choked disks) in 74 per cent of the cases, and the third, fourth, and sixth were seldom involved. The fifth nerve, with the exception of the eighth, was the most commonly affected. Ninety-two per cent of the patients revealed some impairment in sensation in either the face or cornea, corneal sensation alone being diminished in 72 per cent. The seventh nerve was affected in 82 per cent of the series. Every patient had some impairment of hearing, but in 35 of the 50 deafness was complete. Also noteworthy was the fact that the Bárány test was positive in 82 per cent of the group.

The roentgen manifestations of eighth nerve tumors fall into two major categories: those due to increased intracranial pres-

sure, and those due to the local erosive manifestations of the tumor.

The roentgen findings attributable to increased intracranial pressure have been repeatedly described in the literature (7).

In our present series, thinning of the bones of the calvaria, wide sutures (both rather unusual in eighth nerve tumors), and changes in and around the hypophyseal fossa were classical. The hypophyseal changes varied considerably. In approximately half of the patients the fossa was considered enlarged. More common were double hypophyseal floors and erosions of the floor, which occurred in about two-thirds of the series. About 60 per cent revealed early atrophy to frank destruction of the dorsum sellae of the type often seen as a result of third ventricle pressure. The posterior clinoids were affected about twice as often as the anterior clinoids or tuberculum sellae.

In our experience there has been found to exist no consistent relationship between the size of an eighth nerve tumor and the petrosal erosion demonstrated roentgenographically. Small tumors have been seen with massive petrosal destruction, while little damage has been found in some of the larger growths.

For purposes of description, and in order to accentuate the roentgen manifestations of eighth nerve tumors, we previously divided the findings observed radiographically into the six groups listed below (Fig. 1). It is noteworthy that continued experience with this classification seems to justify its concept and use.

Group I: No roentgen abnormalities in the petrosae.

Group II: Slight de-ossification of the internal auditory canal as the only roentgen finding.

Group III: Wide, but not short, internal auditory canals.

Group IV: Short and wide internal auditory canals which in many instances were actually funnel-shaped. (This was the largest group in our series, Fig. 2.)

Group V: Complete destruction of the internal auditory canal, though the petro-

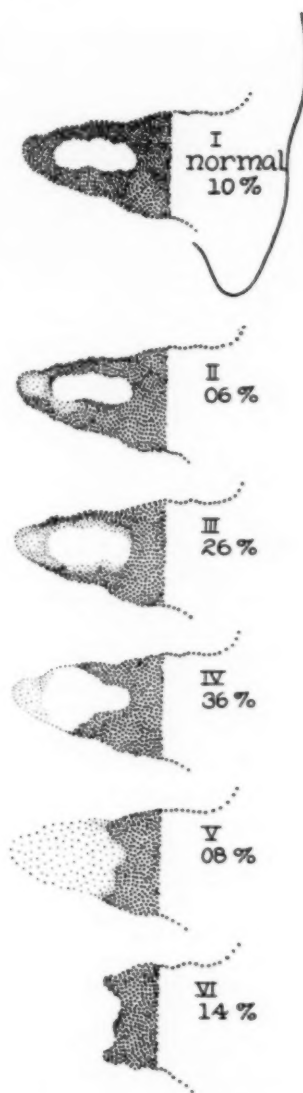


Fig. 1. Diagrammatic appearance of the internal auditory canals and of the petrosal apices observed in patients with eighth nerve tumors. The grouping is based upon the appearance of the petrous pyramid in the occipital or postero-anterior projection. The incidence in each group is indicated by the percentage figure accompanying the diagram.

sal pyramids were still visualized radiographically, albeit considerably demineralized.

Group VI: Complete destruction of the internal auditory canal and the petrosal apex.

In 1948 we reported that the occipital view of the skull was the most informative of all projections used for the detection of angle tumors. We are still of that opinion. The postero-anterior view of the skull, with the internal auditory canals projected into the orbits, is likewise very helpful in many instances. Whereas 85 per cent of all eighth nerve tumors may be localized when both sagittal views are employed, there can be no "short-cuts" in the roentgen examination of the skull for angle tumors. The Hirtz and Stenvers projections are vital parts of the study, as are also routine lateral exposures.

Occasionally angle tumors can be identified only by pneumoencephalography. That these lesions may produce marked dilatation of the third and lateral ventricles long has been known. Also that they may distort the base of the occipital or temporal horns has been recognized. Not until recently, however, were the changes in the sylvian aqueduct and floor of the third ventricle fully appreciated.

The importance of adequate visualization of the aqueduct of Sylvius and the third ventricle in patients with suspected angle tumors has been emphasized by Epstein (3). So important did he consider these midline structures that he advised their visualization by body-section techniques.

Classically, angle tumors may rotate the third ventricle upward and displace the aqueduct dorsally (Figs. 3 and 7). Classically, too, the aqueduct is displaced away from the side of the tumor; sometimes it is rotated upon itself, and not infrequently the caliber of its lumen is decreased or almost obliterated.

Close inspection of the fourth ventricle may reveal changes. Sometimes it may be displaced dorsally and laterally. Occasionally, also, it may appear rotated upon itself. Whereas the floor of the fourth ventricle often is unaffected, one not infrequently observes some distortion and

encroachment upon it, due to direct pressure by the tumor.

CASE I (Fig. 2): C. H., March 7, 1947. A 59-year-old female was admitted to the hospital complaining of tinnitus and loss of hearing in the right ear.

Chronology of Present Symptoms: The patient had first noticed progressive loss of hearing in the right ear some five years before admission. Tinnitus, however, did not begin until about eight months prior to admission. Approximately one year before admission difficulty in walking, with a tendency to fall toward the right side, was observed. At about that time, the patient noticed that her right eye watered considerably. Several months before admission, severe headaches with some blurring of vision occurred for the first time.

Positive Neurological Findings: Bilateral choked disks measuring two diopters were observed, associated with horizontal nystagmus in both eyes. Some hypesthesia was noted in the right side of the face. The right corneal reflex was absent. Hearing was considerably impaired in the right ear. The Romberg test was positive.

Operation: A cerebellopontine angle tumor was found on the right side.

Neuropathology: The specimen consisted of a hard tumor apparently well encapsulated and granular, measuring $2.0 \times 1.5 \times 1.0$ cm. *Microscopic Description:* Acoustic neurinoma.

Roentgen Findings: The bones of the calvaria were negative. The hypophyseal fossa was normal in size and shape, although there was the slightest suggestion of a double floor at its base. The pineal was calcified and not displaced. There was a definite difference in the appearance of the internal auditory canals on both sides; the right was shorter and wider than the normal-appearing one on the left. In addition, films of the base of the skull revealed some impairment of visualization of the foramen ovale and the foramen spinosum on the right side.

Conclusion: Changes in the region of the internal auditory canal on the right side compatible with an eighth nerve tumor.

CASE II (Fig. 3): M. L., May 22, 1948. A 56-year-old woman was admitted to the hospital complaining of severe headaches and vertigo.

Chronology of Symptoms: Severe generalized headaches accompanied by vertigo began to occur in this patient one year before admission. The headaches became progressively more severe and almost constant. Tinnitus and gradual deafness in the left ear followed. Two months prior to admission a staggering gait and numbness in the right hand developed.

Positive Neurological Findings: The patient re-

* Previously reported (5).

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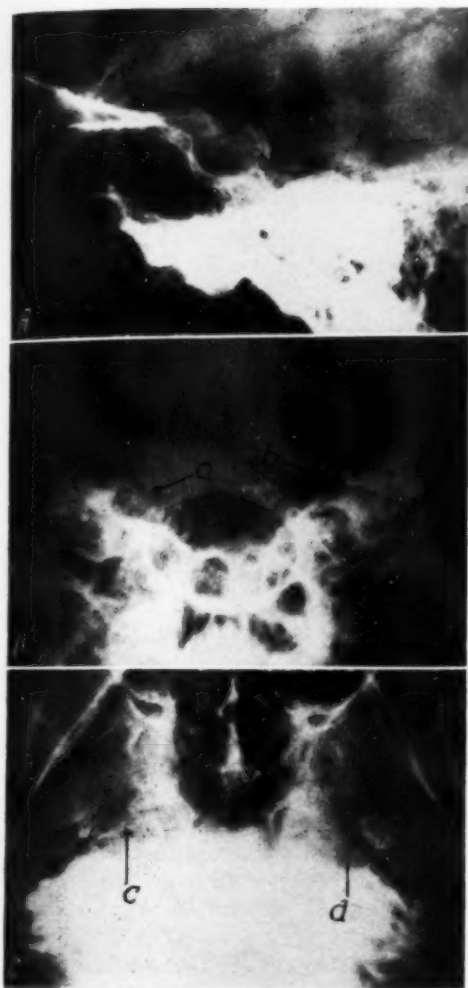


Fig. 2. Case I. Group IV. Right acoustic neuroma.

A. Lateral view. The hypophyseal fossa is normal in size and shape.

B. Occipital view. The right internal auditory canal, *a*, is short, wide, and funnel-shaped compared to the normal appearing left internal auditory canal, *b*.

C. Base view. The right foramen ovale and foramen spinosum, *c*, are eroded and indistinct compared to the normal appearing structures in the middle fossa on the left side at *d*.

See also Fig. 15, D and E.

vealed bilateral papilledema and horizontal nystagmus. Her gait was unsteady and knee and ankle jerks were absent bilaterally. Deafness was almost complete in the left ear. There was bilateral corneal anesthesia. Loss of vibratory and position sensation plus dyssynergia were noted on the left side.



Fig. 2. D and E. D. Base view of the brain revealing the operative site. E. Acoustic neuroma removed surgically at operation.

Operation: A large tumor was removed from the posterior fossa in the region of the left cerebellopontine angle.

Neuropathology: The specimen consisted of many small pieces of tumor without pattern, measuring $4.5 \times 4.0 \times 2.0$ cm. and weighing 7.5 gm. Many small pieces of capsule were present, and the remainder of the tumor was necrotic and friable. In some places it had the characteristic yellow fat color seen in eighth nerve tumors. **Microscopic Description:** Mixture of neurinoma and meningioma.

Roentgen Findings: The bones of the calvaria were normal. The floor of the hypophyseal fossa, the posterior clinoids, and the dorsum sellae were eroded. The pineal gland was not displaced. The left petrosal pyramid was demineralized and the internal auditory canal eroded.

Ventriculogram: The lateral and third ventricles were moderately dilated. The posterior and inferior portions of the third ventricle were displaced upward and encroached upon. The aqueduct of Sylvius and the fourth ventricle were displaced posteriorly.

Conclusion: Findings compatible with a tumor of the left cerebellopontine angle.

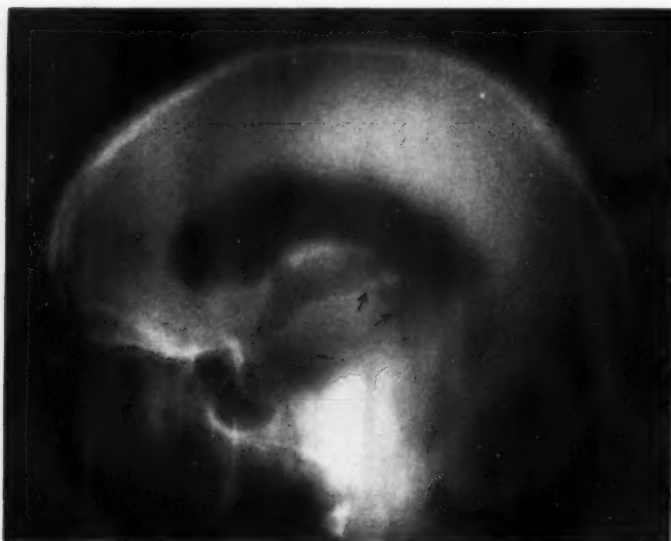


Fig. 3. Case II. A mixture of acoustic neurinoma and meningioma of the left cerebellopontine angle.

Lateral view (body-section film). The lateral and third ventricles are slightly dilated. The posterior and inferior portions of the third ventricle are displaced slightly upward and encroached upon. The aqueduct of Sylvius and fourth ventricle are displaced posteriorly.

MENINGIOMAS

Nineteen patients proved to have angle meningiomas (10.4 per cent). The average duration of symptoms for this group was three years, about twice the duration observed in our patients with acoustic nerve tumors or gliomas. The average age incidence was thirty-nine years. The sexes were equally affected.

The clinical findings in patients with angle meningiomas paralleled those described previously for eighth nerve tumors. Vertigo, loss of hearing, and headaches were common. Visual disturbances and cerebellar symptoms were also encountered frequently.

As in acoustic tumors, deafness was the most common finding in meningiomas of the cerebellopontine angle (92 per cent). Also as in acoustic tumors, involvement of the fifth and seventh nerves was the next most common finding (75 per cent). Visual disturbances and choked disks occurred in 54 per cent of the patients with meningiomas (acoustic nerve tumors, 74 per cent).

The roentgenograms of 15 patients of the 19 with proved angle meningiomas were available for study. Of these, one-third revealed important abnormalities in the region of the cerebellopontine angle which seemed distinctive (Figs. 4 and 5).

In our experience with proved acoustic neurinomas or neurofibromas, increased bone density was never observed in the bones bounding the cerebellopontine angle. In the roentgenograms of the 15 patients with angle meningiomas, however, it was observed 5 times. These were the only instances of such increased bone density in our entire series of angle tumors. In 4 patients of the 5 with increased bone density, the apex of the petrous pyramid alone was affected; in one the dorsum sellae and clivus were affected.

One patient revealed exostosis of the involved petrosal pyramid (Fig. 5). In the others there was no definite change in the configuration of the affected bones, merely a change in texture from the usual cancellous appearance to a dense eburnated pattern. Noteworthy, too, was the ab-

sence of erosions in the porus acusticus in the cases showing increased bone density. Erosions of the internal auditory canal were observed in 3 patients, none of whom revealed eburnated bone. In the latter, the picture could not be differentiated from the erosions of true acoustic nerve tumors.

Eight of the 15 meningioma patients in whom roentgenograms were available revealed radiographic abnormalities in the region of the cerebellopontine angle; in 10 there was roentgen evidence of increased intracranial pressure. In 4 patients routine roentgenograms of the head were considered normal.

CASE III (Fig. 4): H. M., June 29, 1946. A 58 year-old white male was admitted to the hospital complaining of mental disturbances, vertigo, headaches, and blindness.

Chronology of Symptoms: The patient was well until February 1943, when he was in a train accident. No skull fracture was demonstrated but he was unconscious for three days and disoriented for several days after consciousness returned. Four months later he began to have a right-sided weakness and convulsions. One year later his vision became blurred, and six months prior to admission he became blind. During this time he was having hallucinations and personality changes. Paralysis below the waist developed six weeks before admission.

Positive Neurological Findings: Examination revealed bilateral papilledema and horizontal nystagmus. The patient was blind in both eyes and deaf in the right ear. A positive Romberg sign was present. Slight mental dullness and confusion also were noted.

Operation: A large encapsulated tumor was found in the right cerebellopontine angle under the right cerebellar hemisphere, extending through the foramen magnum. The tumor was almost completely removed.

Neuropathology: The specimen consisted of several pieces of tumor covering an area $8 \times 6 \times 2$ cm. The tumor showed gross lobulation in some parts and a fine granular surface of spongy consistency in others. *Microscopic Description:* Meningioma I.

Roentgen Findings: The bones of the calvaria were negative. The hypophyseal fossa was normal in size and shape, but the dorsum and clivus were unusually dense and eburnated. The internal auditory canals were not affected. The pineal gland was not displaced. The right sphenoid ridge was demineralized. The petrosal pyramids were normal.

Conclusion: Changes in the dorsum and clivus compatible with a meningioma in that region.

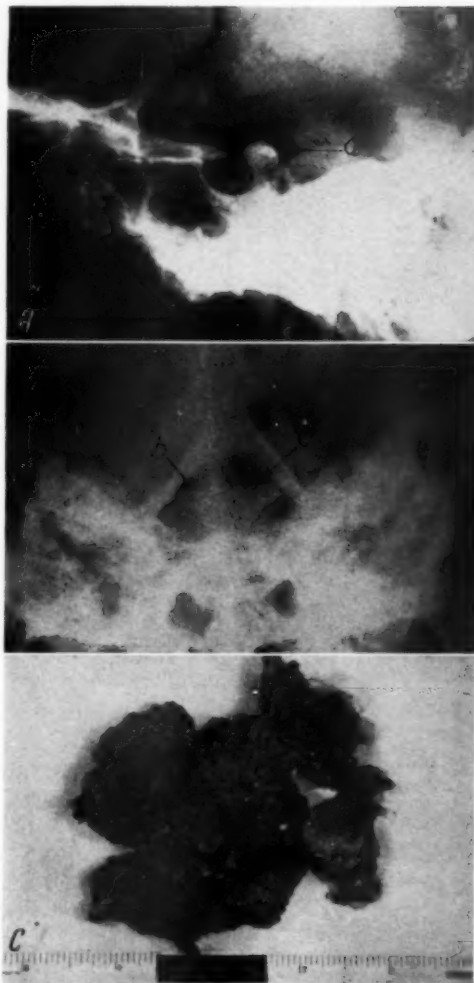


Fig. 4. Case III. Meningioma springing from the region of the dorsum sellae, producing clinical signs and symptoms of an eighth nerve tumor.

A. Lateral view. The hypophyseal fossa is normal in size and shape. The dorsum sellae is unusually dense, *a*, due to the hyperostosis commonly seen in association with meningioma.

B. Occipital view. The dorsum sellae, *b* and *c*, is projected into the foramen magnum, where its eburnated appearance is clearly defined.

C. Tumor tissue removed at operation.

CASE IV (Fig. 5): C. S., April 2, 1947. A 32-year-old colored woman entered the hospital complaining of severe occipital headaches and progressive deafness.

Chronology of Present Symptoms: Severe occipital headaches, lasting only a few minutes, began to occur nine months before admission. Shortly afterwards the patient noticed a progressive loss of hear-

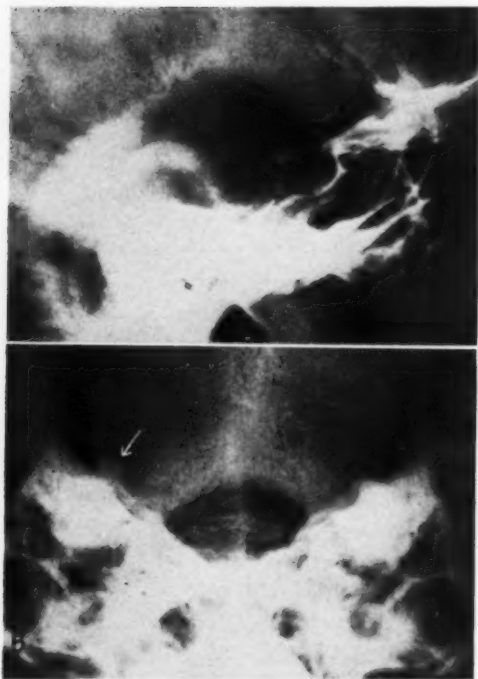


Fig. 5. Case IV. Meningioma of the right cerebellopontine angle.

A. Lateral view. The hypophyseal fossa is normal in size and shape.

B. Occipital view. The right petrosa is eburnated. Note the exostosis springing from the affected petrosal pyramid.

ing in her right ear. During the three months prior to admission, there developed tinnitus in the right ear, vertigo, ataxia, blurred vision, dysphagia, and numbness and weakness of the right side of the face.

Positive Neurological Findings: The patient had mild ataxia and a positive Romberg sign. Her muscle tone and deep reflexes were greater on the left. A mild facial palsy and diminution of the corneal reflex were observed on the right side, and there was hypesthesia of the buccal membrane and right side of the tongue. Bilateral papilledema, impaired phonation, and right ear deafness were also present.

Operation: A large granular tumor was found in the right cerebellopontine angle involving the right hemisphere of the cerebellum and extending *en plaque* along the whole length of the posterior portion of the petrous ridge and through the incisura anterior to the brain stem.

Neuropathology: The specimen consisted of an encapsulated lobulated tumor, measuring $4 \times 3 \times 3$ cm. and a group of small pieces of tumor covering a surface 5.5 cm. square and 1.0 cm. high. All of the tumor masses weighed 32.5 gm. **Microscopic Description:** Meningioma II.

Röntgen Findings: The bones of the calvaria were normal. The hypophyseal fossa was normal in size and shape. The pineal gland was not calcified. There was eburnation of the right petrosa accompanied by exostosis of the petrous apex. The internal auditory canals were normal.

Conclusion: Changes in the right petrosa and right middle fossa compatible with a cerebellopontine angle tumor.

GLIOMAS

Sixteen patients (9 per cent) had proved cerebellopontine angle gliomas. Of these, 9 were astrocytomas, 4 glioblastomas, 1 a spongioblastoma multiforme, 1 a spongioblastoma polare, and 1 a medulloblastoma.

The average duration of symptoms in the glioma group was fifteen months. These tumors seemed to occur more commonly in the younger age group, the average age being eighteen years as compared with forty years for all other forms of angle tumor. Twice as many males were affected as females.

Clinically these patients complained of visual disturbances and headaches. Deafness was far less common than in the acoustic tumor group. Whereas every patient afflicted with an eighth nerve tumor was deaf, there were but 7 patients with angle gliomas who demonstrated variable degrees of deafness (44 per cent). The incidence of seventh nerve involvement was about the same in both groups, 82 per cent for acoustic nerve tumors and 75 per cent for gliomas.

In 10 of the 16 patients with angle gliomas the optic nerve was affected. Six patients revealed third nerve damage and 8 were found with changes in either the fifth or sixth cranial nerve.

The frequency with which multiple cranial nerves were involved in the glioma group interested us. While in other forms of angle tumor involvement of more than one cranial nerve was the rule, in the glioma group the total number of cranial nerves involved was inordinately high. The significance of this observation is questioned, however, because of our limited series of patients with cerebellopontine angle gliomas.

CHOLESTEATOMAS

Seven patients had proved angle cholesteatomas (4 per cent). The duration of the patient's illness was longer in this group than for any other angle tumor in our entire series. Whereas for angle gliomas it was fifteen months, and for acoustic nerve tumors and meningiomas eighteen months and three years respectively, it was five and one-half years for the cholesteatoma group. Males and females were affected equally. The average age of occurrence was forty-one years.

Clinically the signs and symptoms were not distinctive. Headache, deafness, tinnitus, and cerebellar ataxia were common. Every patient revealed changes in the fifth and eighth cranial nerves. Six patients showed abnormalities in the seventh nerve, and 2 in the twelfth nerve. The third, sixth, and eleventh cranial nerves were each affected once.

Roentgenograms of 6 of the 7 patients with angle cholesteatomas were available for study. Two revealed evidence of increased intracranial pressure and also showed erosions of the homolateral internal auditory canal and petrous apex. In a third patient, petrosal apex erosion alone was observed.

An additional roentgen finding merits discussion. Two patients with cholesteatoma of the cerebellopontine angle revealed changes in the homolateral sphenoidal bone in addition to the petrosal pyramid (Fig. 6). In both, the homolateral sphenoidal wing, viewed through the orbit in the postero-anterior projection, seemed de-ossified and distorted, and some distortion was observed also in the homolateral sphenoidal ridge.

At operation both patients were found to have enormous cholesteatomas; they also had histories of long duration. That similar sphenoidal bone changes were not observed in patients with other types of angle disease merits emphasis.

CASE V (Fig. 6): E. C., June 14, 1942. A 53-year-old female entered the hospital complaining of impaired vision and a soreness of the left eye.

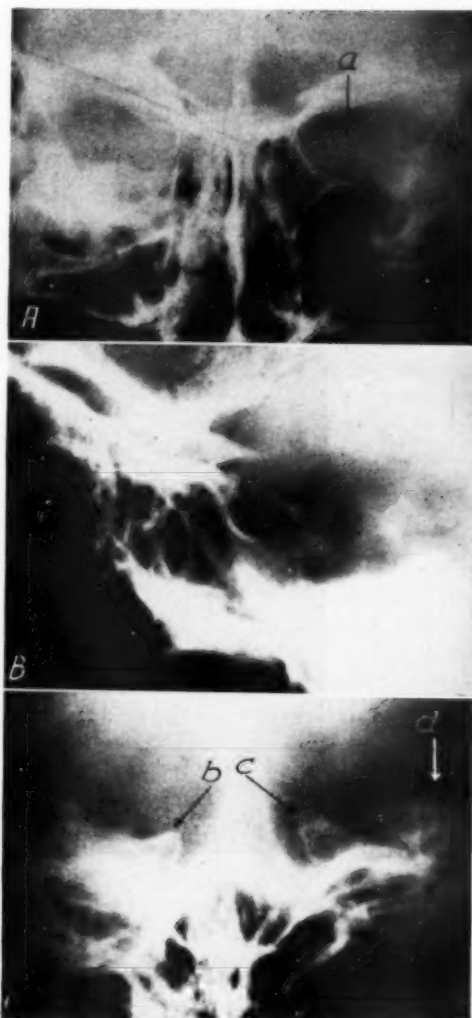


Fig. 6. Case V. Cholesteatoma of the left cerebellopontine angle.

A. Postero-anterior view. The apical portion of the left petrous pyramid is considerably eroded. The wing of the sphenoid, *a*, on the left side is also considerably demineralized and distorted.

B. Lateral view. Whereas the hypophyseal fossa is normal in size and shape, there is considerable atrophy of the dorsum sellae.

C. Postero-anterior projection with the head flexed upon the neck. The anterior clinoid processes are seen at *b* and *c*. The left anterior clinoid, *c*, is considerably distorted compared to the normal appearing right anterior clinoid, *b*.

Chronology of Symptoms: Ten years prior to admission paralysis of the left side of her face had occurred. The paralysis improved rapidly for three weeks, but slight residual weakness and numb-

ness remained. Five years later a progressive deafness and tinnitus developed in the left ear. Shortly before admission impairment of vision and soreness of the left eye were noticed.

Positive Neurological Findings: Hypesthesia and weakness were observed in the left side of the patient's face. Her pharyngeal muscles were weak. Deafness was complete in the left ear, and the left corneal reflex was markedly diminished. The reflexes were hypoactive bilaterally.

Operation: A walnut-sized tumor was found in the left cerebellopontine angle extending into the ventral surface of the pons.

Chronology of Symptoms: At the age of twenty-two years, the patient had hemiparesis following a tonsillectomy. Except for this, she had been well until one year prior to admission, when she noticed tinnitus in her right ear. She then observed increasing difficulty in walking and talking and an occasional right-sided headache.

Positive Neurological Findings: The patient's gait was spastic. Her left pupil was larger than the right, but both reacted normally. She revealed left central facial palsy and left fifth nerve motor weakness. Cerebellar function tests were within normal limits, except for slight dyssynergia on the

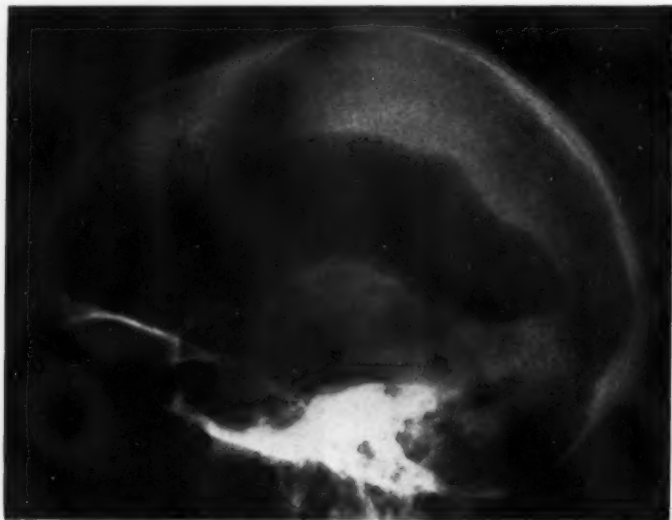


Fig. 7. Case VI. Cholesteatoma of the right cerebellopontine angle, lateral view. The lateral and third ventricles are markedly dilated. The aqueduct of Sylvius and fourth ventricle are displaced posteriorly and encircle a tumor mass, *a*.

Neuropathology: The specimen consisted of many small white pieces of tumor tissue. **Microscopic Description:** Cholesteatoma.

Roentgen Findings: The bones of the calvaria were normal. The pineal gland was not calcified. Even though the hypophyseal fossa was normal in size and shape, there was considerable atrophy of the dorsum sellae. Distortion of the left anterior clinoid process was observed in comparison with the normal appearing right one. The left wing of the sphenoid bone was considerably demineralized and distorted. The left internal auditory canal was completely destroyed, with marked destruction of the left petrous pyramid.

Conclusion: Middle fossa tumor.

CASE VI (Fig. 7). A. D., Sept. 27, 1949. A 49-year-old female entered the hospital complaining of increasing difficulty in walking and talking, headaches, and stiffness of the lumbosacral spine.

left. An increase in the deep tendon reflexes, hypesthesia, analgesia, and ankle clonus were observed on the left. The Babinski test was also positive on the left.

Operation: The left cerebellopontine angle and middle cranial fossa were explored and nothing pathological found.

Neuropathology: Autopsy revealed a large brownish-gray tumor measuring about 3 cm. in diameter, occupying the right cerebellopontine angle, with invasion of the pons, upper medulla, and the left temporal lobe. **Microscopic Description:** Cholesteatoma.

Roentgen Findings: Encephalographic studies revealed marked dilatation of the lateral and third ventricles. The aqueduct of Sylvius and fourth ventricle were displaced posteriorly and encircled the tumor.

Conclusion: Displacement of the aqueduct and fourth ventricle by a brain stem tumor.

MISCELLANEOUS TUMORS

In the miscellaneous tumor group we have placed the single cases of chondromyxoma, chondrosarcoma, metastatic carcinoma, hemorrhagic cyst, and the 3 hemangioblastomas. Their salient features are recorded.

The patient with the *angle chondromyxoma* complained of tinnitus and deafness for fifteen years. The cranial nerves were all involved on the side of the lesion, with the exception of the first, third, and fourth. Roentgenograms of the skull revealed marked petrosal apex distortion plus erosions in the homolateral middle fossa and dorsum sellae.

The patient with the *chondrosarcoma* was not examined roentgenographically. The history of headaches, vomiting, and cerebellar ataxia was of only four weeks duration. The homolateral sixth, seventh, and eighth cranial nerves were involved by the tumor.

Roentgenograms were not obtained in the case of *metastatic carcinoma*. The history of tinnitus and deafness covered a period of ten months. The second and eighth cranial nerves alone were involved.

The patient with the *hemorrhagic cyst* had been ill seven months. He complained of headache and vertigo, but had no eighth nerve symptoms. Roentgenograms of the head were not obtained.

It is interesting to note that the average age incidence of the 3 patients with *angle hemangioblastomas* was fifty-two years, which was older than the other age groups. Also noteworthy was the somewhat shorter average duration of symptoms, namely, one year. The symptoms included tinnitus, headache, and ataxia. In 2 patients, the second, fifth, seventh, and eighth cranial nerves were involved. In only 2 cases were roentgenograms available for study and one of these revealed bone erosion in the petrosal apex associated with atrophy of the dorsum sellae.

DISCUSSION

In spite of the difficulties that beset one trying to differentiate between the various

types of cerebellopontine angle tumors, one is tempted to cull criteria from an experience such as ours that might prove helpful in selected individuals. The shorter clinical history of the glioma group (fifteen months) compared to the longer histories of the meningiomas and cholesteatoma groups (three years and five and one-half years respectively) serves as an excellent example. The fact that the gliomas tend to occur earlier in life also might prove useful. Of value also might be the realization that angle gliomas seem to involve the eighth nerve about half as frequently as other angle tumors, even though they commonly affect multiple cranial nerves.

The fact that meningiomas occasionally cause new bone proliferation in the osseous structures bounding the cerebellopontine angle merits considerable attention. Only in this group of tumors did we recognize eburnation of the petrosal apex, dorsum sellae, or clivus. One must bear in mind, however, that our series also included angle meningiomas which could not be differentiated radiographically from classic acoustic nerve tumors.

Finally, and with some apprehension, we again call attention to the changes noted in the homolateral sphenoidal wing of several patients with angle cholesteatoma. Only in the cholesteatoma group were marked distortions in the ipsilateral sphenoidal wing observed which always were attended by petrosal erosions on the same side. Perhaps the experience of others will add importance to this observation.

SUMMARY

1. Localizing roentgen evidence of acoustic nerve tumors was demonstrated in 85 per cent of the patients here reported.

2. Almost half of the patients with cerebellopontine angle meningiomas revealed roentgen changes of localizing value. Apparently, in some individuals with angle meningiomas bone eburnation and hyperostosis occur in the vicinity of the tumor.

3. In only one patient with a glioma in the cerebellopontine angle were radiographic abnormalities demonstrable in the

petrosal apex. Of interest also was the relatively short history of this type of tumor and its lower age incidence.

4. One-half of the patients with cerebellopontine angle cholesteatomas showed erosion of the internal auditory canal. In addition, unusual degrees of associated ipsilateral sphenoidal bone de-ossification were occasionally observed. The duration of illness was almost twice that observed in the other groups of angle tumors.

NOTE: We wish to thank Dr. Francis C. Grant and Dr. Robert A. Groff for allowing us to use their material. We are indebted also to Dr. Finkelstein of the Graduate Hospital, who has been extremely helpful and co-operative.

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SUMARIO

Tumores del Angulo Cerebelopontil: Sus Manifestaciones Roentgenológicas

Esta comunicación pone al día las observaciones de los AA. en los tumores del nervio auditivo, previamente expuestas en *Radiology* (**53**: 633, 1949), abarcando además los protocolos de todos los demás enfermos operados en los Hospitales de la Universidad de Pennsylvania por síndromes neoplásicos del ángulo cerebelopontil, en que las neoplasias no resultaron ser neuromas del octavo par. La serie comprende 183 casos: 134 fueron tumores del nervio auditivo, 19 meningiomas, 16 gliomas, 7 colesteatomas del ángulo cerebelopontil, 3 hemangioblastomas y 1 cada uno de metástasis carcinomatosa, hemorragia encapsulada, condrosarcoma y condromioma. En 85 por ciento de los enfermos mencionados, se descubrieron signos roentgenológicos que localizaban los tumores del octavo par.

Casi la mitad de los enfermos con

meningiomas del ángulo cerebelopontil revelaron alteraciones roentgenológicas de valor localizador. Aparentemente, en algunos de esos individuos, aparecen eburnación ósea e hiperosteosis en la vecindad del tumor.

En un solo enfermo con glioma del ángulo cerebelopontil había anomalías radiográficas observables en el vértice del peñasco. También eran interesantes la historia relativamente breve de esta clase de tumor y su incidencia a una edad tierna.

La mitad de los enfermos con colesteatomas del ángulo cerebelopontil mostraban erosión del conducto auditivo interno. Además, observóse de cuando en los mismos inusitada desosificación del esfenoidal ipsilateral. La duración de la dolencia en estos casos fué casi el doble que la observada en los otros grupos de tumores cerebelopontiles.

Angiographic Demonstration of an Anatomic Variation in the Position of the Transverse Dural Sinuses¹

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THE SUPERIOR sagittal sinus, its entering veins, and the straight sinus are often seen on cerebral angiograms. The position of the transverse sinuses is less well defined radiologically. While their anatomic positions are well known, there has been little mention of possible varia-

sinus is considered an extension of the straight sinus, while the right, commonly believed to be the larger of the two, is regarded as an extension of the superior sagittal sinus. Just before their terminations, they rest on a groove on the mastoid part of the temporal bone, where they are

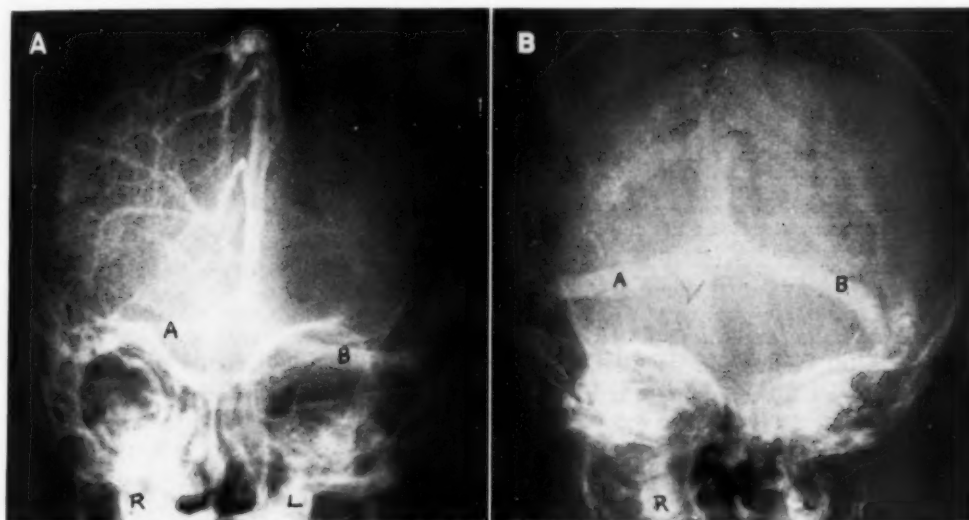


Fig. 1. A. Venous phase of cerebral angiogram, anteroposterior view. Diodrast visualizes the cerebral veins and the superior sagittal sinus. The right and left transverse sinuses (A and B) are adequately visualized. These are symmetrically situated.

B. Cerebral angiogram of same patient made within an hour after the creation of a right common carotid-internal jugular anastomosis, with the diodrast injected beneath the anastomotic site. Diodrast flows directly across both transverse sinuses (A and B). The position of the transverse sinuses is the same as seen in the pre-operative film (A).

tions. In the present communication a variation in the usual situation of the transverse sinuses will be described.

The transverse sinuses originate in the torcula Herophili at the internal occipital protuberance and extend laterally in the attached margins of the tentorium cerebelli to terminate in the jugular veins at the jugular foramina. The left transverse

referred to as the sigmoid sinuses because of their curved configurations. The transverse sinuses receive blood from the superior petrosal sinuses at the base of the petrous portions of the temporal bones, and they communicate with the veins of the pericranium by means of the mastoid and condyloid emissary veins. Blood is also received from the inferior

¹ From the Radiologic Service of The Jewish Hospital of Brooklyn, Brooklyn, N. Y. Accepted for publication in February 1951.

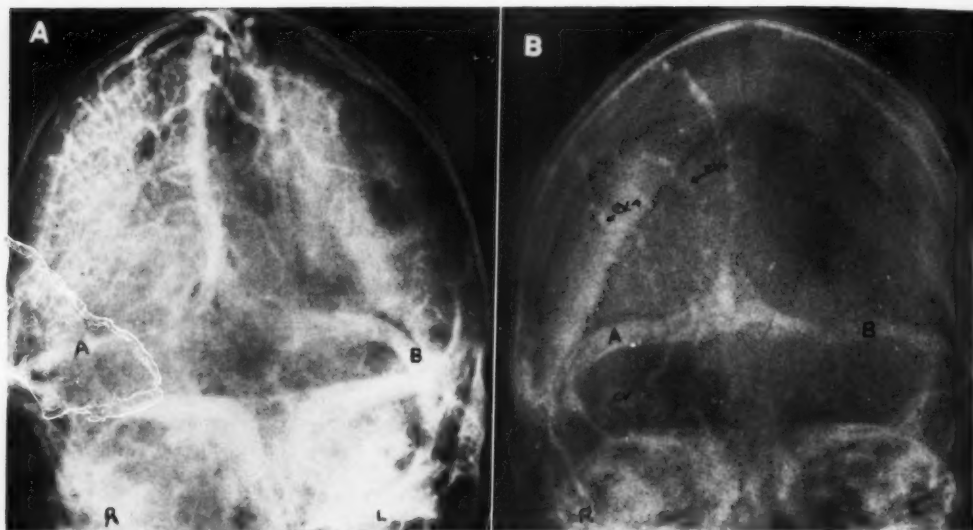


Fig. 2. A. Venous phase of cerebral angiogram, anteroposterior view. Diodrast visualizes the cerebral veins and the superior sagittal sinus. The right and left transverse sinuses (A and B) are well visualized and are symmetrically placed.

B. Cerebral angiogram of same patient made five weeks after the creation of a right common carotid-internal jugular anastomosis, with diodrast injected beneath the anastomotic site. The diodrast flows across the transverse sinuses (A and B), which are situated symmetrically in their normal positions. There is no change in the position of the transverse sinuses as compared with the preoperative angiogram. Collateral venous circulation (cv) is visible in the basilar veins and in the veins of the scalp.

cerebellar veins and the diploic veins. The occipital sinus, the smallest of the cranial dural sinuses, is situated in the attached margin of the falx cerebelli. It is usually a single channel arising around the margin of the foramen magnum from several small venous passages communicating with the posterior interior vertebral venous plexus, and empties into the torcula Herophili.

During an investigation of the intracranial circulatory effects of common carotid-internal jugular vein anastomosis, cerebral angiograms were made immediately before and after the anastomosis was established. This operation was proposed by Beck, McKhann and Belnap (1), who suggested that anastomosis of these vessels might increase the cerebral circulation and thereby improve the condition of children with convulsive disorders and mental retardation. The study was continued by means of additional cerebral angiograms at intervals up to five months,

in order to assess the later effects of the anastomosis. Our results (2), which are very much the same as obtained in animals by Gurdjian, Webster and Martin (3), showed that this change in the circulatory dynamics shunted the blood across the transverse sinuses, thereby diminishing rather than augmenting the cerebral circulation (Fig. 1). Angiograms made at later intervals after operation demonstrated the development of anastomotic venous plexuses about the foramen magnum, the face, and the scalp (Fig. 2). The postoperative angiograms showed the transverse sinuses to much better advantage than those obtained preoperatively.

In 2 out of 11 patients an anomalous position of the transverse sinuses was noted, one on the left and the other on the right side. In one the preoperative angiogram did not show the transverse sinuses adequately, while the postoperative angiogram revealed the atypical situa-

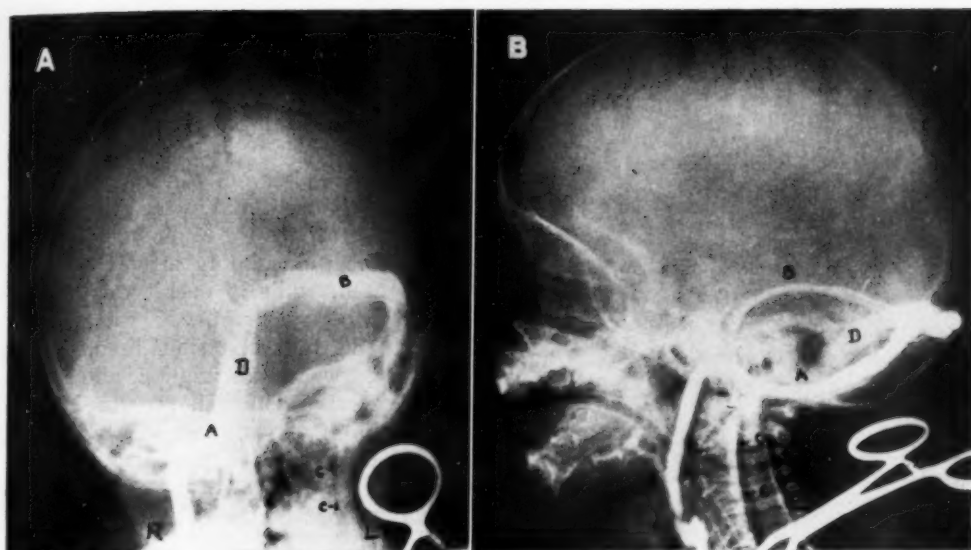


Fig. 3. A. Cerebral angiogram made about one hour after the creation of a right common carotid-internal jugular anastomosis, with the diodrast injected beneath the point of anastomosis. The diodrast enters the right transverse sinus (A), which is situated asymmetrically, and is displaced toward the midline. The left transverse sinus (B) is in its normal location. The diodrast can be seen in the left internal jugular vein (C). Just medial to the right transverse sinus is another channel, believed to be the occipital sinus (D).

B. Lateral cerebral angiogram of same patient made immediately after the anteroposterior angiogram, with the needle still below the point of anastomosis. The diodrast flows into the displaced right transverse sinus (A) across the torcula Herophili into the left transverse sinus (B) and out the left internal jugular vein (C). The channel between the transverse sinuses (D) is believed to be the occipital sinus.

tion of the right transverse sinus (Fig. 3). In the second the anomalous position of the left transverse sinus was demonstrated preoperatively (Fig. 4).

In each instance, the atypically situated transverse sinus was displaced toward the midline. In one, diodrast could be seen passing up the jugular vein into the skull, so that the right transverse sinus rose almost perpendicularly to the torcula Herophili while the left transverse sinus followed its usual course to the periphery of the skull and thence downward to the left jugular vein. In the anteroposterior view another vessel could be seen just medial to the transverse sinus. This was believed to be the occipital sinus. In the lateral view the anomalous right transverse sinus could be seen well below the level of the left transverse sinus, and the occipital sinus was visible between the two transverse sinuses. The continuity of both transverse sinuses with the jugu-

lar veins was particularly well demonstrated. In the second case the right transverse sinus was normal in position, while the left appeared to be somewhat smaller and deflected toward the midline.

The question arises as to whether this anomalous position might be due to circulatory changes incident to the creation of a carotid-jugular anastomosis. Inasmuch as the anomaly was demonstrable in one case before operation, and in both within an hour after operation, it would appear to be a safe assumption that the operation had nothing to do with its appearance. The development of collateral circulation after operation may take from a few weeks to several months. In the cases followed by us, this collateral circulation caused no change in the position of the transverse sinuses (Fig. 2).

In a review of angiograms made for a variety of other conditions, principally in



Fig. 4. Preoperative anteroposterior angiogram, venous phase. Diodrast is seen in the right transverse sinus (A), which is in its normal situation. The left transverse sinus is not in its normal position. A channel is seen directed downward from the torcula Herophili which is believed to be an anomalous left transverse sinus (B). The postoperative angiogram also showed this change in the position of the left transverse sinus.

adults, no similar alterations in the configuration of the transverse sinuses were observed. Apparently the incidence of medial displacement of the transverse dural sinuses is low.

SUMARIO

Demostración Angiográfica de Una Variación Anatómica en la Posición de los Senos Transversos de la Duramadre

En 2 de 11 enfermos en que se había verificado una anastomosis carótido-yugular conforme a la técnica de Beck, McKhann y Belnap, observóse una posición anómala de los senos transversos. En uno, esto fué a la derecha y en el otro a la izquierda. En ambos la posición anómala era visible inmediatamente después de crear la fístula, en tanto que en uno se

SUMMARY

In 2 of 11 patients who had had carotid-jugular anastomosis according to the technique of Beck, McKhann and Belnap, an anomalous position of the transverse sinuses was observed. In one, this occurred on the right and in the other on the left side. In both the anomalous position was visible immediately after the fistula was created, while in one it was demonstrated also on a preoperative angiogram. In both the transverse sinus involved was displaced toward the midline, and in one another venous channel, presumed to be the occipital sinus, was dilated. This alteration in position appears to be unrelated to the operative effects. It is probably of congenital origin.

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descubrió además en un angiograma preoperatorio. En ambos, el seno transversal afectado estaba desplazado hacia la línea media; uno revelaba dilatación de otro conducto venoso, siendo éste presuntamente el seno occipital. Esta alteración de la posición de los senos no parece guardar relación con los efectos de la operación, siendo probablemente congénita.

Effect of Roentgen Radiation on Thyroid Function in Rats¹

JOHN B. HURSH, Ph.D., PRISCILLA A. Van VALKENBURG, B.A., and JOHN B. MOHNEY, M.D.²

THE EXPERIMENTS to be reported were designed to study the effects of local roentgen irradiation of the rat thyroid on the ability of that gland to take up circulating iodine and to transform it into an undialyzable complex. Iodine was injected in the form of the eight-day isotope, I^{131} , and the analyses were performed by the usual counter technic. Some incidental histologic examinations were made and autoradiographs of the thyroid were prepared. The broad objective of the experiment was to provide additional information on the radiation dose necessary to impair thyroid function. The full realization of this objective was defeated by the circumstance that death of the rat followed local irradiation of the thyroid at any dose greater than the maximum used in the present experiment (6,000 r in two equal doses, twenty-four hours apart), a level which produced no thyroid damage detectable by histologic examination or by the functional tests employed. Although the x-ray dose could not be pushed to the point necessary to produce thyroid damage, the converse effect, *i.e.*, an apparent stimulation of thyroid gland function, was produced at certain doses and post-irradiation times.

Earlier investigators (1-6) have studied the effect of radiation on the thyroid using either x-rays or radium as the radiation source. The consensus of the findings with roentgen irradiation is that the thyroids showed no histologic changes at total local radiation doses as high as 2,400 r delivered at the rate of 330 r every second day to guinea-pigs (1), 5,500 r delivered at the rate of 550 r per day to rabbits (5), 4,620 r delivered in dose units of 385 r at intervals

from seven to fourteen days apart over a period of about five months to dogs (2). Experimenters variously report no effect on the basal metabolic rate in guinea-pigs (1) and an increase in the metabolic rate (7) in rabbits (dose, 5 to 25 r). One group of investigators (3) reports an impairment of the ability of the irradiated thyroid of the guinea-pig to respond to anterior pituitary extract.

Since the experiments were started in this laboratory, three papers have been published bearing on the question of radiosensitivity of the thyroid gland. Bender (8) has reported that doses of roentgen radiation from 50 to 4,500 r (single dose) to the thyroid had no effect on the oxygen consumption of rats. Findlay and Leblond (9) have measured oxygen consumption and made histologic studies on two rats receiving 78 and 61 μ c. of radioiodine respectively, corresponding to a dose of about 20,000 roentgens equivalent physical (rep) as calculated by the authors. Decreases in oxygen consumption and destructive histologic changes were found in both animals. Skanse (10) has studied the effect of a range of doses of I^{131} (1, 10, 50 μ c) on the thyroid gland of the cockerel. The types of effect measured were growth, collection of iodine, capacity to respond to thiouracil and to thyrotropic hormone. The animals receiving 1 μ c (dose = 1,700 rep) showed no differences from controls. At the other dose levels, impairment of function due to radiation effects was observed.

It may therefore be taken as generally agreed that the normal thyroid is radio-resistant to the extent that a single dose of 4,500 r has no effect that can be identified

¹ From the Department of Radiation Biology, The University of Rochester School of Medicine and Dentistry, Rochester, N. Y. Accepted for publication in January 1951.

This paper is based on work performed under contract with the United States Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, N. Y.

² Now at Medical College of Alabama, Birmingham, Ala.

histologically or perhaps functionally. At the dose level of about 20,000 rep³ damaging effects can be demonstrated.

Preliminary experiments performed by the authors (11) using single doses of 1,000 r did not reveal any differences between experimental and control rats in respect to uptake of I¹³¹. A second series of experiments performed at higher doses is described in this report.

EXPERIMENTAL METHODS

Male and female adult albino rats were used as experimental animals. Their weights ranged from about 200 to 300 gm. They were maintained on a synthetic low-iodine diet prior to sacrifice for at least twenty-three days. The diet was composed of glucose, 48 per cent; casein, 20 per cent; brewers' yeast, 8 per cent; crisco, 10 per cent; salt mixture No. 2, 4 per cent.⁴

A single rat was kept in each cage. The cages were racked in a rat room in which the radiator heat was controlled by thermostat. The animals were handled in groups of three, variously composed of one control and two irradiated, three irradiated, or three control rats. For purposes of irradiation the rats were anesthetized with nembutal, placed in a supine position with head extended on a rat board, and loosely wrapped with a bandage. The thyroid was located by palpation and hair was clipped off the skin directly above the located site.

Irradiation was carried out at 15 ma., 250 kv., with an aluminum plus copper filter such that the half-value layer was 2.15 mm. of copper. Total doses of 3,000, 4,500, or 6,000 r were delivered to the thyroid. The tube-to-skin distance was 30 cm., and the radiation was given

at a rate of 67 r per minute. When 4,500 and 6,000 r were used, the radiation was delivered in two equal doses twenty-four hours apart. The animals were shielded with lead except for the thyroids, which were exposed through a 1.5 cm. circular aperture in the shield.

The experimental rats were sacrificed at various chosen times after receiving radiation. On the day of sacrifice a small dose of I¹³¹ (3.5 to 8.0 μ c.) was injected into the caudal vein. Four hours after injection the animals were killed and the thyroid glands dissected out. Samples of blood were drawn for analysis.

The thyroid tissue was prepared for I¹³¹ analysis by thoroughly homogenizing in a blender with the addition of a few milliliters of KI-containing solution at pH 12.5. The homogenate was made up to 10 ml. volume with the KI solution. A suitable small aliquot was deposited as small droplets regularly disposed on the counting area of a small circular silver foil. The droplets were evaporated to dryness with gentle heat from an infra-red lamp. The beta emission of the prepared foil was measured by means of a calibrated Geiger-Müller counter.

A second aliquot of the homogenized thyroid material was dialyzed for twelve hours in a continuous-flow, recirculating apparatus such that the dialysate, as well as the undialyzable material, was available for I¹³¹ analysis. Sample foils of both components were made up as described above and counted for beta activity.

EXPERIMENTAL RESULTS

Effect of Roentgen Radiation on the Ability of the Thyroid Gland to Take Up Iodine: The data for uptake of I¹³¹ by the thyroid gland are presented in Table I. These data fall into a recognizable pattern leading to the conclusion that irradiation at the levels of 3,000 to 6,000 r brings about an increased I¹³¹ uptake and that the amount of the increase is greater the larger the dose of radiation and the longer the post-irradiation testing time within the limits investigated. The single exception to this gen-

³ The calculation of radiation dose from I¹³¹ assumes equal spatial distribution of iodine within the thyroid gland. This is most certainly not the case and therefore the calculated dose is less than the local real dose.

⁴ The salt mixture, obtained from Nutritional Biochemicals Corp., Cleveland, Ohio, contained the following components: calcium biphosphate, 13.58 per cent; calcium lactate, 32.70 per cent; ferric citrate, 2.97 per cent; sodium biphosphate, 8.72 per cent; sodium chloride, 4.35 per cent; magnesium sulfate, 13.70 per cent; potassium phosphate, 23.98 per cent.

eralization occurs in the 6,000 r, 21-day group. Since this group contains only two animals, the exceptional value is not regarded as invalidating the above interpretation.

TABLE I: EFFECT OF 3,000, 4,500, AND 6,000 R ON THE PER CENT DOSE IN THE THYROID GLAND FOUR HOURS AFTER I^{131} INJECTION

Group	Number of Rats	Mean	Standard Deviation of the Mean†
Control	12	9.52	1.11
7:3,000*	6	10.00	1.57
14:3,000	9	12.46	1.28
21:3,000	8	14.50	1.36
21:4,500	4	17.22	1.92
7-8:6,000	3	13.93	1.57
14:6,000	4	20.88	1.92
21:6,000	2	9.35	2.72

* 7:3,000 signifies seven days post-irradiation, radiation dose 3,000 r.

† The standard deviations were calculated as follows: It was considered that the uncontrolled factors in the experiment operated equally on all post-irradiation groups. Therefore, an over-all variance was calculated by finding the sum of the squares of the differences between the mean and the experimental values within each post-irradiation group, adding these sums for the different groups, and dividing by the sum of one less than the number of rats in each group. The combined variance was found to be 14.77. The variance of the mean for each group becomes 14.77 divided by the number of animals in the group. The standard deviation of the mean is the square root of the variance.

Autoradiographs of Thyroids of Control and Irradiated Rats: Four rats of equivalent ages were selected. Three animals were irradiated with 1,000 r, 3,000 r, and 6,000 r. Twenty-one days post-irradiation, all 4 animals were intravenously injected with 7 μ c. of I^{131} . After four hours the animals were sacrificed and the thyroid glands were dissected out, fixed, and mounted in a single paraffin block. Autoradiographs⁵ were made from sections of the block. Photomicrographs of the autoradiographs are reproduced in Figure 1 and numbered 1, 2, 3, and 4, denoting thyroids from the control, and from the rats receiving 1,000 r, 3,000 r, and 6,000 r respectively. The figure confirms the analytical findings in that the spot sample illustrated indicates a greater concentration of I^{131} in the 3,000 and 6,000 r thyroids than in the un-

TABLE II: I^{131} IN THYROID (BOUND) AND IN PLASMA (TOTAL) FOUR HOURS AFTER I^{131} INJECTION

Experimental Groups	Thyroid Bound I^{131} Per Cent†	Per Cent Dose per Gram Plasma
Controls	98.2	0.415
7:3,000*	97.6	0.560
14:3,000	98.7	0.495
21:3,000	98.7	0.438
21:4,500	98.1	0.378
8:6,000	98.9	0.754
14:6,000	98.6	0.325
21:6,000	97.8	0.455

* Signifies seven days post irradiation; radiation dose, 3,000 r.

† Average bound I^{131} in per cent of total thyroid I^{131} .

irradiated thyroid. The 1,000 r thyroid appears to have accumulated more iodine than the normal thyroid but less than those irradiated with the higher dose.

Effect of Radiation on the Ability of the Thyroid Gland to Bind Iodine: An additional function of the physiologically normal thyroid, apart from its ability to concentrate inorganic iodine from the blood, is its action in binding the iodine in an organic complex. These functions of the thyroid are separable, as can be readily demonstrated by administering thiouracil compounds, which still allow concentration of iodide by the gland but block its ability to bind the iodide in an organic complex. The effect of radiation on the ability of the thyroid to bind iodide was investigated by dialyzing the thyroid homogenate as described above. The results are presented in Table II as thyroid bound I^{131} calculated as per cent of the sum of the dialyzed and undialyzed I^{131} . It is apparent that the irradiation has not affected the ability of the thyroid to bind inorganic iodine.

Condition of I^{131} in the Blood: Table II lists, also, the average per cent dose per gram plasma at the time of sacrifice, *i.e.*, four hours after administration of the iodine. There appears to be no significant difference between the controls and irradiated rats in this respect.

Systemic Effects Following Local Irradiation of the Thyroid: Although the rats were shielded with lead except for the thyroid area, the tissues below and surrounding this region received a certain amount of

⁵ Mr. George A. Boyd, formerly of this laboratory, supervised the preparation of the autoradiographs.

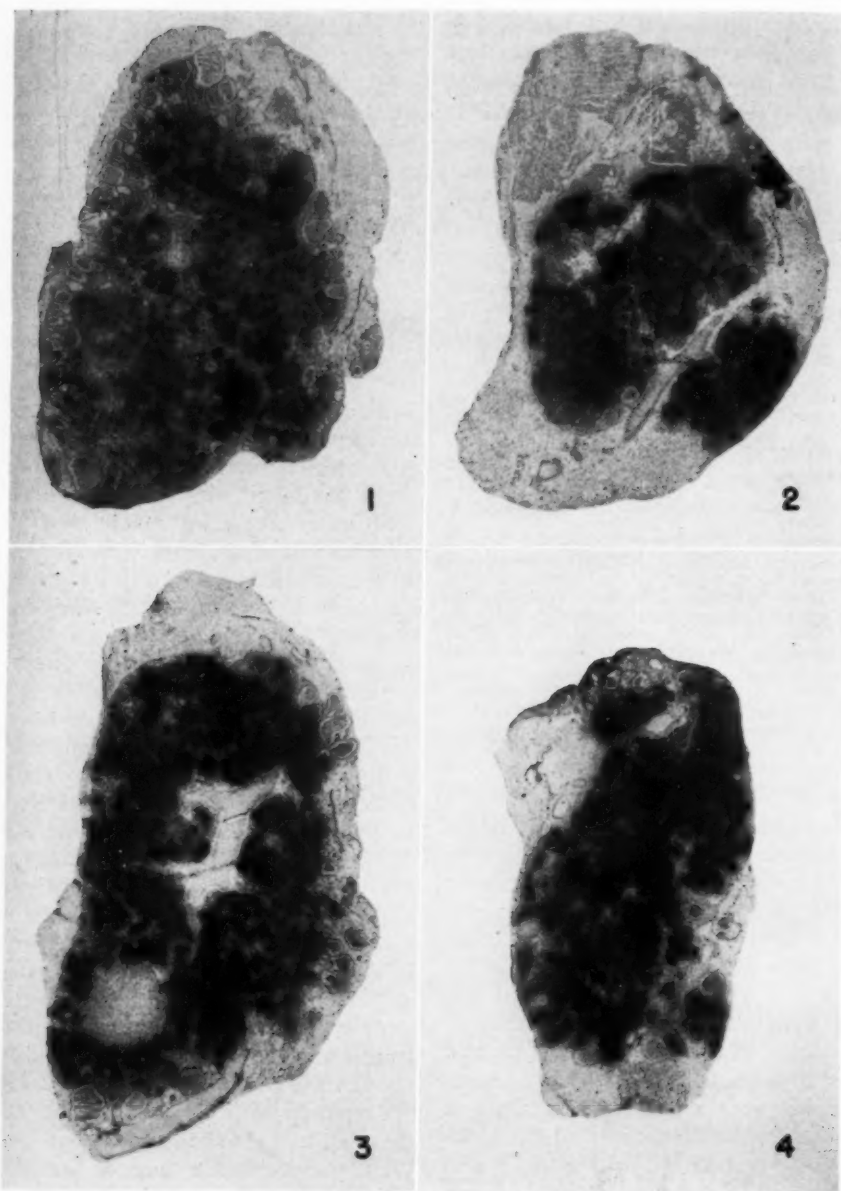


Fig 1. Autoradiographs of thyroid tissue from a control rat (1) and from animals receiving 1,000 r (2), 3,000 r (3), and 6,000 r (4).

radiation. Pencil ionization chambers were placed at various sites around and under the body of a dead rat and a mock irradiation was carried out for a dose of 1,500 r delivered to the thyroid. The position of

the chambers and scattered doses measured are charted in Figure 2.

It would appear that the dose is rather well confined to the thyroid and the other tissues in its immediate vicinity. This in-

ference is borne out by pathological studies⁶ made on three rats in the 3,000 r series. Tissues examined histologically in one or more of the rats included the thyroid, cervical lymph nodes, cecal lymph nodes, thymus gland, esophagus, submaxillary gland, small intestines, spleen, and femoral bone marrow. With the exception of a mild cortical hypoplasia in cervical lymph nodes, no changes were found which could be unequivocally related to irradiation.

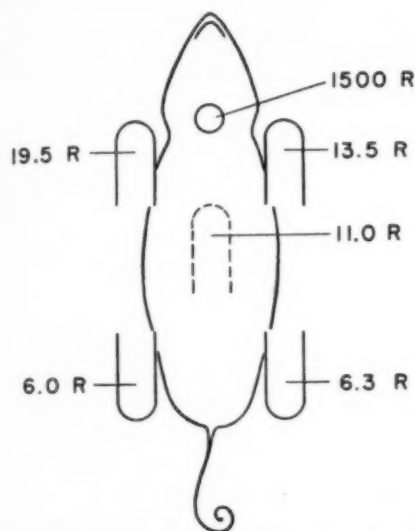


Fig. 2. Schematic plot of scattered radiation as measured by pencil chambers at the sites indicated.

In spite of the minimal histologic findings, the existence of a systemic effect is unquestionable. A prominent symptom is a transitory reduction in food consumption and loss of weight. Daily food consumption measurements were made on the 3,000 r and 6,000 r rats. Some of the data are plotted in Figure 3. The graph shows two drops in food consumption, the first may, in part, be related to the anesthesia, but the second, beginning about the fifth day, is certainly an effect of the radiation. It is seen that the larger radiation dose is associated with a somewhat greater decline in food consumption and a somewhat longer

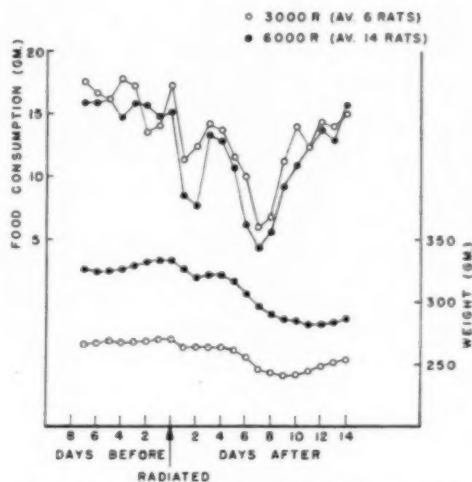


Fig. 3. Effect of roentgen irradiation limited to the thyroid area on food consumption and body weight.

recovery time. Weight data are also plotted in Figure 3. Corresponding to reduced food intake there is a weight loss in both radiation groups.

DISCUSSION

The results of the experiments appear to fall into a pattern indicating that roentgen irradiation at a dose level of 3,000 to 6,000 r causes an increased uptake of I^{131} by the thyroid gland. The amount of increase in uptake appears to become greater with increased radiation dose and with increase in post-irradiation time between seven and twenty-one days.

The question may be asked, is this an indirect effect on the thyroid mediated by a systemic response of the whole organism or should it be regarded as a direct effect on the thyroid tissue itself? The experiments do present evidence for a systemic response to local irradiation of the thyroid area. As shown in Figure 3, beginning about the fifth day after irradiation there is a marked reduction in food intake. This reduction in food intake is not believed to be related to radiation effects on the esophagus, since histologic examination of a 3,000 r animal sacrificed at seven days revealed no changes in the esophageal tissue sections.

⁶ The authors are indebted to George W. Casarett of this laboratory, who performed the pathological studies.

In view of this evidence of a systemic effect, the hypothesis that the apparent stimulation of thyroid function is secondary to a primary unidentified destructive effect of roentgen radiation certainly cannot be rejected. The analogy with the production of leukocytosis following irradiation is an evident one.

An even closer analogy may be drawn between the present experiments and the work of Evans and his associates (12), in which rats receiving whole body irradiation (500 and 1,000 r) were found to concentrate iodine in the thyroid gland to a greater extent than control rats.⁷ The report is in abstract and does not list the order of concentration but does state that a more pronounced effect was obtained when the radiation was confined to the abdominal region. Although the scattered radiation in the present experiment is lower by a factor of 10 (for most of the rat's body) than the whole body dose administered by Evans and co-workers, the experiments of the latter workers demonstrate that the thyroid will take up increased iodine following irradiation of the body as a whole with the thyroid shielded.

The alternative hypothesis, supposing a direct stimulating effect on the thyroid, seems unlikely on a basis of the negative histologic findings reported in this paper as well as in others. The absence of histologic changes at the radiation doses producing the stimulating effects has a special weight as evidence against the direct-action hypothesis, since the diseases of the thyroid in which avidity for plasma iodine is increased are characteristically associated with the well known hyperplastic and hypertrophic cellular changes.

The reports in the literature purporting to show stimulation of the thyroid (increased basal metabolism rate and hyperplasia) have been discussed by Bender (8). On what appear to be reasonable grounds, he judges the evidence for stimulation unconvincing. Bender's experiments fail to

show any effect on basal metabolism rate or on histologic structure of the thyroid following x-ray doses of 50 to 4,500 r delivered locally to the rat thyroid. To what extent are these findings in conflict with the experimental results of the present investigation? In both studies the rat was used as the experimental animal and the experimental conditions were very similar. In both, a 1.5 cm.-diameter portal was used directly over the thyroid area; the radiation dose range overlapped in the 3,000 r to 6,000 r range.⁸

The experimental results are in agreement in that no histologic changes could be detected in the irradiated animals. It would seem likely, however, since more iodine was taken up and bound in an undialyzable complex by the irradiated rat thyroids when the dose was 3,000 to 6,000 r, that the production of thyroxine would occur at a greater rate and that the basal metabolic rate would show an increase. The basal metabolism rates reported by Bender are in the form of monthly averages for the adult rat experiments and are interpreted as showing no consistent change after irradiation for any dose between 50 and 4,500 r. The pertinent data for comparison purposes (*i.e.*, radiation dose of 3,000 r or greater) are derived from two adult rats at 4,500 r and two young rats at 4,000 r. In both these sets of data small increases in the average basal metabolism rate occur at greater post-irradiation times. These metabolic rate increases are considerably smaller (all less than 10 per cent of the initial pre-irradiation level) than the increases in iodine uptake reported in the present paper and are stated by Bender not to be significant.

The original purpose of the studies reported above was to investigate the x-ray dose necessary to destroy thyroid tissue. The upper dose limit for the local application of roentgen radiation to the thyroid is in the neighborhood of 5,000 r delivered as a single dose. At higher dosages the rats refuse to eat and lose weight steadily

⁷ The authors of the present paper became aware of this report just prior to submission of their experiments for publication.

⁸ The 6,000 r divided dose used would be equivalent to a single dose of 5,000 r.

until death occurs. The rats receiving 6,000 r as a divided dose (equivalent in this instance to about 5,000 r as a single dose) displayed no destructive changes of the thyroid tissue as determined by spot histologic examination, and their ability to concentrate iodine in the thyroid, far from being reduced, was somewhat increased.

The above finding cannot be applied directly to human hyperthyroid patients receiving a calculated dose of 3,700 rep from the fixing of 1 mc. of I^{131} in a 30-gm. thyroid. Such a dose may well cause a degree of thyroid tissue destruction, whereas 3,700 r delivered as roentgen radiation might have no effect. This comes about since the calculation of dose is based on the assumption of even distribution and this is far from the case (see Figure 1). A second pertinent factor may be the increased radiosensitivity of the hyperplastic (human) thyroid compared to the normal (rat) gland. Finally, the familiar problem of the extrapolation of rat data to humans makes the interpretation subject to uncertainty.

Investigation of the effect of radiation on the thyroid at dose levels higher than 5,000 r must rely on use of I^{131} , which selectively concentrates in the gland. This has the disadvantage of unequal irradiation to different parts of the gland and a continuously changing rate of irradiation. For these reasons a measurement of radiation sensitivity of the thyroid as carried out by the I^{131} method requires a knowledge of the maximum concentration at the site of the damaged cells and, strictly speaking, can be compared to roentgen radiation measurements on other tissues only if corrections are made for the different rates at which the radiation was delivered.

SUMMARY

Rats were irradiated by x-rays applied locally to the thyroid area at total dose levels of 3,000, 4,500, and 6,000 r. Thyroid function was tested by injecting I^{131} at various intervals after irradiation, sacrificing the animals four hours after injection, and analyzing the excised thyroid gland for uptake of I^{131} , as well as the percentage

of I^{131} bound in an undialyzable complex. Histologic sections of the thyroids were prepared and examined.

In the rats receiving 3,000 r and 6,000 r the iodine uptake was greater than in the control rats, and the increase was greater the higher the x-ray dose and the longer the post-irradiation interval within the limits investigated. In spite of the increased iodine uptake, no morphological changes of the thyroids could be found at these dose levels on the basis of examination of random sections. The increased uptake is tentatively regarded as an indirect consequence of a systemic response to radiation.

The level of local roentgen irradiation necessary to produce destruction of thyroid tissue is greater than the highest dose (about 5,000 r delivered as a single dose) which can be administered to a rat without causing its death.

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SUMARIO

Efecto de la Radiación Roentgen sobre la Función Tiroidea en las Ratas

Se irradiaron ratas con rayos X aplicados localmente a la zona del tiroides a dosis totales de 3,000, 4,000 y 6,000 r. La función tiroidea fué comprobada inyectando I^{131} a varios plazos después de la irradiación, sacrificando los animales cuatro horas después de la inyección y analizando los tiroides excindidos con respecto a absorción de I^{131} , así como el porcentaje de I^{131} fijado en un complejo indializable. También se prepararon y examinaron cortes histológicos de los tiroides.

En las ratas que recibieron 3,000 y 6,000 r, la absorción de yodo fué mayor que en las testigos, siendo mayor el aumento mientras más alta la dosis de rayos X y

más largo el plazo consecutivo a la irradiación dentro de los límites investigados. A pesar de la mayor absorción de yodo, no pudieron descubrirse alteraciones morfológicas de los tiroides con las dosis mencionadas a base del examen de cortes tomados al azar. La mayor absorción se considera tentativamente como consecuencia indirecta de una respuesta orgánica a la radiación.

El tenor de irradiación roentgen local necesario para producir la destrucción del tejido tiroideo es mayor que la dosis más alta (unos 5,000 r entregados en una sola dosis) que cabe administrar a una rata sin ocasionar la muerte de la misma.



Lethal Irradiation of Mice with High Doses of Roentgen and Gamma Rays¹

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Paris, France

ROENTGEN IRRADIATION

Experimental Procedure: White mice of a heterogeneous population obtained by cross-breeding several strains were divided into groups of 10 animals each and were irradiated over a wide dosage range, under identical conditions, with a D.E.W. 215 type tungsten anticathode Siemens tube.² The factors were as follows: 200 kv., 10 ma., 1.0 mm. Al filtration, maximum output 470 r per minute at 23 cm. Various dosimeters (Hammer, Strauss, Küstner, Victoreen) were tried, but the best results were obtained with small graphite-bakelite ionization chambers (1) put at our disposal by Dr. L. H. Gray,³ which permitted direct determination of the total energy absorbed by the mice (2).

Following irradiation, the animals were observed at frequent intervals so as to determine as accurately as possible the survival time. From the individual survival times for each dose, the mean survival time and its standard deviation were calculated by the log-probits graphical statistical method (3), the Bliss group correction (4) being previously made.

For lethal irradiation, the mean survival time seems to be a satisfactory measure of radiosensitivity of an animal population, and its variation coefficient gives the amplitude of natural or induced variations of such radiosensitivity (Fig. 1).

Experimental Results: The curve reproduced in Figure 2, based on 943 animals, shows the relation of dose to mean survival time. Four areas are apparent:

(1) The first deaths followed irradiation

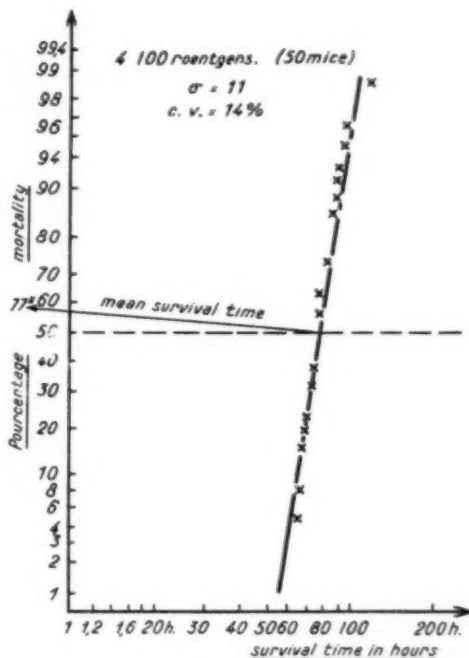


Figure 1

with 100 r and the mortality rate increased rapidly with the dose, reaching 100 per cent at 800 to 1,000 r (5). After a period of normal behavior—the so-called latent period—the classical signs of radiation sickness appeared. The coats of the animals became dull and shaggy and they displayed asthenia, diarrhea, nystagmus, kyphosis, emaciation, and dyspnea prior to death.

(2) From 800 r to about 13,000 r an interesting phenomenon was observed, expressed on the curve by a plateau. In

¹ From the Institut du Radium, Paris. Presented at the Sixth International Congress of Radiology, London, July 24-28, 1950.

² For the use of this tube we are indebted to M. Chassende-Baroze, Director of the Centre d'Electroradiologie du Service de Sante Militaire at the Vanves Fort.

³ The electrometric measurements were made in Dr. Gray's service, Hammersmith Hospital, London, by Messrs. Boag and Wilson, to whom we wish to express our appreciation.

this dose range the mean survival time remained relatively constant at 80 hours, in spite of variation of dosage in a ratio as high as 1 to 15.

This observation may be explainable by the "impact theory," assuming that death is due to injury of a "target" corresponding to an essential vital mechanism. This

probability) of this target may account for the individual variations in radioresistance.

(3) From 13,000 r the survival time gradually diminishes as the dose increases, and after a shorter latent period the animals show symptoms of a much more acute and rapid poisoning. This is manifested chiefly by a remarkable hyperexcita-

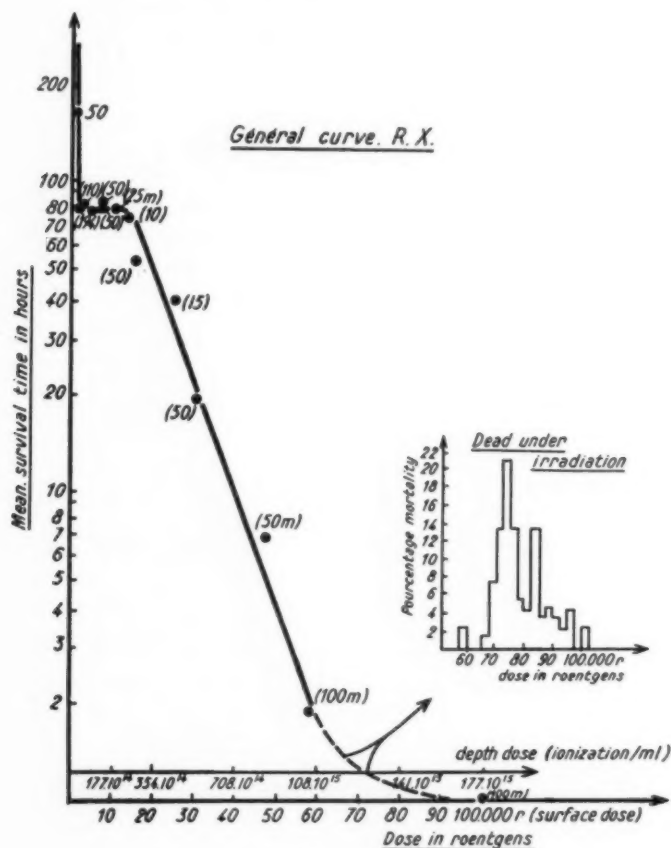


Figure 2

target would be a small but highly radiosensitive fraction of the body⁴, and the ionization produced outside of this "sensitive volume" would be practically ineffective until a dose of 13,000 r was attained. A variation of both the cross section (hit probability) and radiosensitivity (action

⁴ According to recent experiments (Jacobson; Ellinger), this target is probably the spleen.

bility (convulsions, abnormal activity in the form of jumping or capering about) and loss of position sense, both horizontal (waltzing, running backwards) and vertical (crooked running, drowning on swimming test). This acute poisoning seems to be due to a general cytolysis resulting from massive body irradiation—a cytolysis by which are liberated highly toxic products

whose concentration in the tissues increases with increased dosage.

(4) At 60,000 r delivered with maximum intensity (470 r per minute) the first deaths during irradiation are recorded. The mortality rate rapidly increases from this point until it reaches 100 per cent at about 100,000 r, with a mean survival time

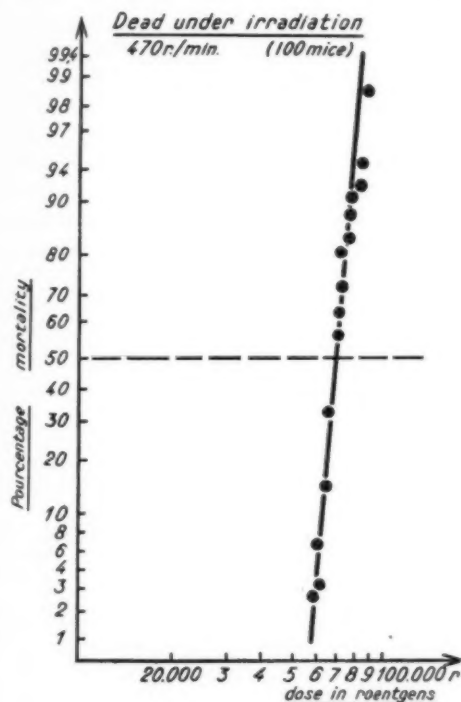


Figure 3

of only two and a half hours. The survival time during irradiation is determined by the same graphical method described above (Figs. 2 and 3).

These different stages of radiation poisoning and the existence of a plateau between 800 and 13,000 r during which the variation coefficient would be at a minimum seem to be confirmed by the dose-variation curve (Fig. 4).

Influence of Different Factors on Survival Time; Attempts at Treatment: For experiments to determine the influence of various factors on survival time, the dose of 1,000 r was chosen, corresponding approximately

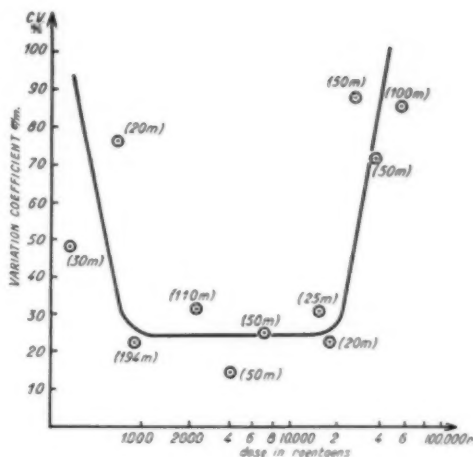


Figure 4

to the beginning of the plateau in the curve of Figure 2 and giving a 100 per cent mortality with a convenient survival period (80 hours). It was hoped that with this dose an effective treatment might be discovered, as indicated by its effect on the survival rate and prolongation of survival. The results were on the negative side. No effect was obtained by prolonging the irradiation (intensities from 4 to 470 r per minute). Variations due to the age or body weight of the animal were found to be slight and fell within the normal limits of fluctuation. Sex appeared to be without significant influence.

Treatment by physical agents (6 meter short-wave therapy, intense illumination or darkness, infrared or ultraviolet irradiation) was without effect, nor was any significant modification of the results obtained by injections of horse serum, even in massive doses, either before or following irradiation (6), or by desoxycorticosterone (7).

The foregoing observations are, of course, valid only for the dose of radiation employed. They do not exclude a possible significant effect of the factors mentioned at a lower dose range. Experiments with lower doses are, however, more difficult, because of the increase in both the survival time and its variation coefficient. A longer observation of a large series of animals is

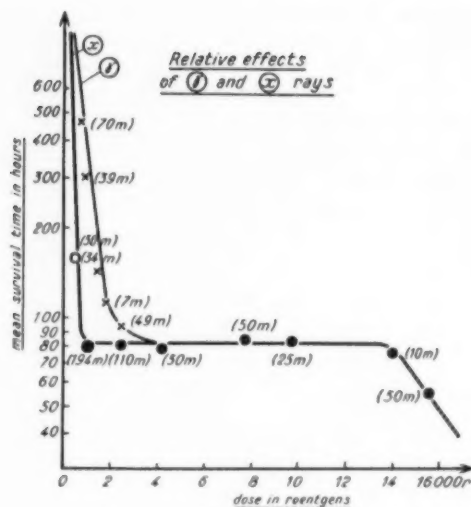


Figure 5

necessary for statistically significant conclusions.

GAMMA RAYS

For experiments with gamma rays, 200 mice of the same origin as those used in the roentgen ray studies were divided into groups of 7, and each group was placed in a paraffin block and exposed to the radiation from a 10-gm. radium source,⁵ filtered through 3 mm. Pb, 2 cm. wood, and 5 cm. paraffin, at a distance of 15 cm. The dose of radiation received was measured by the graphite-bakelite ionization chambers used in the experiments with roentgen irradiation. The roentgen and gamma ray doses so measured corresponded fairly well to the energy actually absorbed by the mice (2) and are directly comparable.

The maximum intensity of the radium source, 3 r per minute, made it possible to construct only the first part of the curve

⁵ The telecurietherapy bomb of the Institut du Cancer, Villejuif, for the use of which we are indebted to Prof. Huguenin and Mme. S. Laborde.

showing relation of dose to mean survival time (Fig. 5), probably up to the beginning of the plateau in the corresponding curve for roentgen irradiation. When the two curves are compared, it is observed that, while they are of the same general type, they are not parallel, indicating that the ratio of effectiveness of the two types of radiation is dependent upon the dose. This ratio is found to vary between 2.1 and 3.6. It seems to be higher than that observed for other biological effects (2, 8).

Though the animals irradiated with roentgen and gamma rays show identical symptoms of poisoning, a greater amount of gamma energy than of roentgen energy must be liberated in the tissues for similar biological effects. It appears reasonable to attribute this fact to different primary radiochemical reactions (9) resulting from unequal ion distribution along the electronic path of the two radiations.

Laboratoire Curie
11, Rue Pierre-Curie
Paris (5^e), France

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SUMARIO

La Irradiación Letal de los Ratones con Dosis Altas de Rayos X y Gamma

Para la irradiación letal el tiempo medio de sobrevivencia parece ser una medida satisfactoria de la radiosensibilidad de una población animal. Una curva construida a base de las observaciones realizadas en 943 ratones expuestos a dosis altas de radiación roentgen muestra la relación del tiempo de sobrevivencia con la dosis. Las primeras muertes ocurrieron después de una dosis de 100 r y a partir de ahí la tasa de mortalidad aumentó rápidamente llegando a 100 por ciento al administrarse 800 a 1,000 r. Desde este punto hasta 13,000 r el tiempo medio de sobrevivencia permaneció relativamente constante a 80 horas, disminuyendo gradualmente a medida que se aumentaba más la dosis. Las primeras muertes durante la irradiación

ocurrieron con una dosis de 60,000 r, entregada a intensidad máxima (470 r por minuto), y a 100,000 r el tiempo medio de sobrevivencia sólo fué de dos horas y media.

Con dosis de 1,000 r el tiempo de sobrevivencia no fué afectado por la edad, sexo o peso de los animales, por la prolongación del tiempo de irradiación, o por el tratamiento con agentes físicos (terapéutica de onda corta, irradiación ultravioleta e infrarroja, etc.), inyecciones de suero de caballo o desoxicorticosterona.

Ratones de la misma raza irradiados con rayos gamma mostraron síntomas idénticos de envenenamiento, pero para obtener los mismos efectos biológicos se necesitó una dosis mayor de energía gamma que de X.



EDITORIAL

Invitation to the Annual Meeting

The Thirty-seventh Annual Meeting of the Radiological Society of North America will be held at the Palmer House, in Chicago, from Dec. 2 through Dec. 7, 1951.

You are cordially invited to this 1951 meeting. It would have been a source of pride and satisfaction to your President to have been able to invite you to Denver, but accommodations there are not sufficient for a gathering such as we of the Radiological Society have come to expect each December. Chicago not only offers the necessary accommodations but because of its central location is readily accessible to our widely scattered membership. The selection of the Palmer House as a meeting place is a splendid one since the hotel facilities are ample to house the scientific and technical exhibits, and the rooms that are available for the Refresher Courses are unequalled.

The Program Committee has arranged a well rounded, diversified program that should make a special appeal not only to the members of the Society but to all those attending the meeting. The sessions open with the Refresher Courses, beginning Sunday afternoon and evening and continuing daily from 8:30 A.M. to 10:00 A.M. This interesting part of our program has become an indispensable and highly popular feature of our annual meeting. This year will be no exception, as Dr. Virden and his committee are introducing some new subjects and rearranging the courses.

The Scientific Sessions will all be held in the ballroom. As at last year's meeting, and in accordance with many requests, diagnostic and therapeutic programs will not be presented simultaneously in different rooms. The Program Committee has divided the program so that there is an approximately equal number of diagnostic and therapeutic papers.

The Chairman of the Scientific Exhibits Committee is Dr. Ivan J. Miller. He and his Committee have arranged a superb exhibit covering many scientific problems. Some of the exhibits amplify and extend the papers on the Scientific Program.

Excellent exhibits have also been arranged by the Commercial Exhibits Committee, of which Dr. Theodore J. Wachowski is chairman. These should prove of great interest and profit, and should be attended by all, especially since sufficient time has been allowed between the Refresher Courses and the Scientific Sessions for that purpose.

The Annual Carman Lecture, an outstanding feature of our meeting, will be given Tuesday evening by one of our Past Presidents, who is an authority on Atomic Warfare, Dr. Robert S. Stone. His subject will be "The Concept of a Maximum Permissible Exposure."

Business sessions of the Society will be held Monday, Tuesday, and Thursday afternoons. Time has been set aside for these meetings to give ample opportunity to conduct the important business of the Society without interfering with the rest of the program or rushing through the business without due deliberation.

Social functions have not been neglected. The Local Ladies Committee, of which Mrs. John H. Gilmore and Mrs. Warren W. Furey are Co-chairmen, has arranged an excellent and varied program for the visiting ladies. The Annual Banquet will be held Thursday evening. This year there is to be well chosen entertainment so you cannot afford to miss this occasion.

This preview of activities is presented as a greeting from your officers and as an official invitation to meet us in Chicago, in December.

JOHN S. BOUSLOG, M.D.
President

REFRESHER COURSES: POST-GRADUATE INSTRUCTION

The 1951 Refresher Course series will be presented at the Thirty-seventh Annual Meeting of the Radiological Society of North America, at the Palmer House, Chicago, Ill. The courses open with "Therapy Information—Problem Cases" at 2:30 P.M. Sunday, Dec. 2, followed by Film-Reading at 7 P.M.

Commencing Monday, Dec. 3, there will be seven courses daily from 8:30 to 10 A.M. No other meetings will be scheduled during these hours. Attendance is limited to members of the medical profession (M.D.'s) including graduate students and residents in Radiology and to radiation physicists.

Admission to the courses will be by ticket only.

Non-members will be charged \$3.00 for each course up to a maximum of \$10.00 for the series. No charge will be made to reserve officers still on

active duty, residents or fellows in Radiology, or members-elect.

Read the description of the courses, noting particularly the days upon which they are offered, and make your selection for each day. State your first, second, and third preferences, as in some instances the number attending each course must be limited by the seating capacity of the room.

If your application is received prior to Nov. 25, your tickets will be mailed to you. Later than that they will be held at the Registration Desk in the Palmer House. If the courses are not filled by the time of the meeting, the remaining tickets will be available at the Registration Desk.

It may be necessary to revise some courses or to change some instructors. We shall, however, adhere as closely as possible to the printed program.

Course No. 1: Sunday, 2:30–5 P.M.

Therapy Information—Problem Cases

L. HENRY GARLAND, M.D., San Francisco, Calif.
T. LEUCUTIA, M.D., Detroit, Mich.
CHARLES L. MARTIN, M.D., Dallas, Tex.
RALPH PHILLIPS, M.D., New York

MILTON FRIEDMAN, M.D., New York, Moderator

Ten representative lesions treated with irradiation have been selected. Diagrams, photographs, microscopic slides, and details of treatment have previously been sent to the members of the panel. The results of the treatment will be withheld. Each member will discuss the treatment given, indicating how and why his own technic would differ.

The eventual outcome of the case will then be disclosed. A final attempt will be made to resolve differences in technic.

Course No. 2: Sunday, 7–9 P.M.

Film-Reading Session

CARROLL C. DUNDON, M.D., Los Angeles, Calif.
HAROLD O. PETERSON, M.D., Minneapolis, Minn.
PAUL C. SWENSON, M.D., Philadelphia, Penna.
SYDNEY F. THOMAS, M.D., Palo Alto, Calif.

LEO G. RIGLER, M.D., Minneapolis, Minn., Moderator

This session is a diagnostic clinic with presentation of the methods of examination in selected cases. The cases to be discussed will be chosen by the Chicago Roentgen Ray Society and the Kansas City X-ray Society, but any member of the Radiological Society who desires to present an instructive case may submit his case to the moderator, Dr. Leo G. Rigler, University of Minnesota Medical School, Minneapolis 14, Minn.

Course No. 3: Monday, 8:30–10:00 A.M.

Myelography

HAROLD O. PETERSON, M.D.

University of Minnesota, Minneapolis, Minn.

A detailed description of the technic of doing a spinal puncture and injecting and removing the contrast medium will be presented. If this technic is followed closely a 99 per cent removal of lipiodol or pantopaque can be obtained 95 per cent of the time without any discomfort to the patient. Many of the pitfalls of improper technic will be illustrated. Diagnosis will be limited to the ruptured disk. If time permits, the technic of disk puncture will be described and a few cases presented.

Course No. 4: Monday, 8:30–10 A.M.

Dosimetry in Radium Therapy

EDITH H. QUIMBY, Sc.D., Physicist

Columbia University, New York

The development of dosage units for radium therapy will be traced briefly. Various charts and tables for determination of dosage in roentgens will be presented and precautions regarding their use discussed. Most of the period will be devoted to working out practical problems. An exhibit on dosage calculation will probably be presented.

Course No. 5: Monday, 8:30–10:00 A.M.

Fundamentals of Roentgen Therapy

ROGER A. HARVEY, M.D.

University of Illinois, Chicago, Ill.

Session 1: The discussion will stress methods of

patient selection or assignment, relation of tumor type to response, mode of action of ionizing radiations, aims of treatment, and treatment planning.

The latter will include selection of portals, method of determining dose distribution in tumor zones and healthy tissue zones unavoidably irradiated, and time-dose relationships.

Session 2: The discussion will include manifestations of response, reactions and their management, radiation sickness, relationship of hormone administration to roentgen therapy, and inadequate roentgen therapy.

A brief summary of the contribution of some of the high-energy accelerators to clinical radiation therapy will be made.

There will be a question and answer period near the end of each session.

(This course continued Tuesday, Course No. 12)

Course No. 6: Monday, 8:30-10:00 A.M.

Diagnosis and Treatment of Malignant Tumors of the Female Genital Tract

HAROLD WM. JACOX, M.D.

Presbyterian Hospital, New York

1. The natural course and incidence of only the common malignant conditions will be discussed:

- (a) Carcinoma of the cervix.
- (b) Carcinoma of the fundus.
- (c) Carcinoma of the ovary.
- (d) Carcinoma of the vulva.

2. Emphasis will be placed upon practical clinical fundamentals as a working basis.

3. The relationship of surgery to irradiation will be brought out.

4. The relationship of the various methods of irradiation will be considered.

5. Details and timing of technics used at the Presbyterian Hospital, New York City, will be reviewed from the standpoint of tissue dose estimation.

6. Complications will be considered with a view to minimizing them.

7. Time will be allowed for questions and discussions.

(This course continued Tuesday, Course No. 13)

Course No. 7: Monday, 8:30-10:00 A.M.

Dental Roentgenologic Interpretation

EDWARD C. STAFNE, D.D.S.

**Section on Dentistry, Mayo Clinic
Rochester, Minn.**

The first session will deal with dental caries, periapical and periodontal disease, and more common pathologic conditions which involve the teeth and their supporting structures. It will include cysts

and tumors of the jaws, with special emphasis on those of dental origin, also a discussion of the effects of irradiation and radioactive substances on the teeth and jaws.

The second session will be devoted largely to dental and oral manifestations of systemic disease as revealed by the dental roentgenogram. It will include those manifestations which are associated with endocrinopathy, developmental disturbances of the skeleton, granulomatous diseases, and some other conditions in which they may be present.

(This course continued Tuesday, Course No. 14)

Course No. 8: Monday, 8:30-10:00 A.M.

Roentgen Diagnosis of the Arthropathies

A. A. deLORIMIER, M.D.

Saint Francis Hospital, San Francisco

Casual observation of roentgenograms of joints may lead one to identify most cases either as atrophic or hypertrophic "arthritis." This stunted point of view may be due to improper technical precautions; it may be due to lack of comprehensive thinking with respect to the common types of arthropathies; it may be due to oversight of tangible roentgen criteria. These three aspects of responsibility on the part of roentgenologists will be considered, with portrayals by lantern slides.

(This course continued Tuesday, Course No. 15)

Course No. 9: Monday, 8:30-10:00 A.M.

Upper Gastrointestinal Tract and Colon

CESARE GIANTURCO, M.D.

Carle Hospital Clinic, Urbana, Ill.

This course will include lantern slide demonstrations of normal and pathological appearances of the esophagus, stomach, duodenum, and colon. Special emphasis will be placed on the method of visceral survey and on the technic of gastric double contrast and of high-voltage radiography for the examination of the colon.

(This course continued Tuesday, Course No. 16)

Course No. 10: Tuesday, 8:30-10:00 A.M.

Venography

E. C. BAKER, M.D.

**The Youngstown Hospital Association
Youngstown, Ohio**

Past history will be reviewed. Venous anatomy, especially of the lower extremity, as shown by normal and abnormal venograms will be demonstrated. Emphasis will be placed on the physiology of blood flow as shown by serial venograms. Questions of technic will be considered. A number of pathological findings will be shown.

Course No. 11: Tuesday, 8:30-10:00 A.M.**Physics of X-radiation and Isotopes****K. E. CORRIGAN, Ph.D.****The Harper Hospital, Detroit, Mich.**

Physical problems associated with the modern use of high-voltage equipment and radioactive substances require physics laboratories which can be supported only by large institutions having large population areas to serve. Such an installation, however, can serve the needs of many smaller institutions and individual radiologists throughout the surrounding geographic area up to 200 miles or more. Modern radiation techniques require the use of these expensive installations. Modern therapeutic and diagnostic procedures force upon the medical practitioner of radiology physical problems which he cannot be expected to solve by himself. An extensive teaching program is a part of the duties of the larger institution.

The manner in which this general problem has been managed in Michigan over a period of years forms the basis of the course. The actual physical problems and their application to clinical situations will be illustrated. The first period will deal with physical problems which arise in radiation therapy in general. The second will deal specifically with isotope problems.

(This course continued Wednesday, Course No. 18)

Course No. 12: Tuesday, 8:30-10:00 A.M.**Fundamentals of Roentgen Therapy****ROGER A. HARVEY, M.D.**

(Continued from Monday, Course No. 5)

Course No. 13: Tuesday, 8:30-10:00 A.M.**Diagnosis and Treatment of Malignant Tumors of the Female Genital Tract****HAROLD WM. JACOX, M.D.**

(Continued from Monday, Course No. 6)

Course No. 14: Tuesday, 8:30-10:00 A.M.**Dental Roentgenologic Interpretation****EDWARD C. STAFNE, D.D.S.**

(Continued from Monday, Course No. 7)

Course No. 15: Tuesday, 8:30-10:00 A.M.**Roentgen Diagnosis of the Arthropathies****A. A. deLORIMIER, M.D.**

(Continued from Monday, Course No. 8)

Course No. 16: Tuesday, 8:30-10:00 A.M.**Upper Gastrointestinal Tract and Colon****CESARE GIANTURCO, M.D.**

(Continued from Monday, Course No. 9)

Course No. 17: Wednesday, 8:30-10:00 A.M.**Angiocardiography****F. J. HODGES, M.D.****W. M. WHITEHOUSE, M.D.****M. M. FIGLEY, M.D.****University of Michigan, Ann Arbor, Mich.**

A brief review of the development of angiocardiography will preface detailed consideration of technique of examination and interpretation. Normal morphologic and physiologic features will be emphasized. Original films projected directly will be used to illustrate the usefulness of angiocardiography in the study of congenital heart disease, differential diagnosis of mediastinal lesions and other miscellaneous conditions. Some discussion will concern thoracic aortography. An attempt will be made to indicate the relative importance of angiocardiography in the whole spectrum of diagnostic radiology.

Course No. 18: Wednesday, 8:30-10:00 A.M.**Physics of X-radiation and Isotopes****K. E. CORRIGAN, Ph.D.**

(Continued from Tuesday, Course No. 11)

Course No. 19: Wednesday, 8:30-10:00 A.M.**Roentgen Therapy in Cancer of the Hypopharynx and Larynx****RALPH M. CAULK, M.D.****Garfield Memorial Hospital, Washington, D. C.**

A careful study of our material from the standpoint of history, physical and radiographic examination, has given criteria for determining the site of origin and extent of the disease. These factors have been shown to be exceedingly important in the prognosis from the point of view of roentgen therapy.

Survival rates for lesions of the various anatomical sites will be shown on lantern slides.

The quality of the voice of patients previously treated will be demonstrated by a tape recording.

Course No. 20: Wednesday, 8:30-10:00 A.M.**Diseases of the Chest in Infants and Children****JOHN F. HOLT, M.D.****University Hospital, Ann Arbor, Mich.**

This course is basically a systematic review of primarily non-tuberculous abnormalities of the

Plan of Presentation

SUNDAY, Dec. 2 2:30-5 P.M.	MONDAY, Dec. 3 8:30-10 A.M.	TUESDAY, Dec. 4 8:30-10 A.M.
1. Therapy Information L. Henry Garland, M.D. T. Leucutia, M.D. Charles L. Martin, M.D. Ralph Phillips, M.D. Milton Friedman, M.D., Moderator	3. Myelography Harold O. Peterson, M.D.	10. Venography E. C. Baker, M.D.
	4. Dosimetry in Radium Therapy Edith H. Quimby, Sc.D.	11. Physics of X-radiation and Isotopes (Continued Wednesday) K. E. Corrigan, Ph.D.
	5. Fundamentals of Roentgen Therapy (Continued Tuesday) Roger A. Harvey, M.D.	12. Fundamentals of Roentgen Therapy (Continued from Monday) Roger A. Harvey, M.D.
	6. Diagnosis and Treatment of Malignant Tumors of the Female Genital Tract (Continued Tuesday) Harold Wm. Jacox, M.D.	13. Diagnosis and Treatment of Malignant Tumors of the Female Genital Tract (Continued from Monday) Harold Wm. Jacox, M.D.
7-9 P.M.		
2. Film-Reading Session Carroll C. Dundon, M.D. Harold O. Peterson, M.D. Paul C. Swenson, M.D. Sydney F. Thomas, M.D. Leo G. Rigler, M.D., Moderator	7. Dental Roentgenologic Interpretation (Continued Tuesday) Edward C. Stafne, D.D.S.	14. Dental Roentgenologic Interpretation (Continued from Monday) Edward C. Stafne, D.D.S.
	8. Roentgen Diagnosis of the Arthropathies (Continued Tuesday) A. A. deLorimier, M.D.	15. Roentgen Diagnosis of the Arthropathies (Continued from Monday) A. A. deLorimier, M.D.
	9. Upper Gastrointestinal Tract and Colon (Continued Tuesday) Cesare Gianturco, M.D.	16. Upper Gastrointestinal Tract and Colon (Continued from Monday) Cesare Gianturco, M.D.

Plan of Presentation

WEDNESDAY, Dec. 5 8:30-10 A.M.	THURSDAY, Dec. 6 8:30-10 A.M.	FRIDAY, Dec. 7 8:30-10 A.M.
17. Angiocardiography F. J. Hodges, M.D. W. M. Whitehouse, M.D. M. M. Figley, M.D.	24. Abdominal Arteriography David Shapiro, M.D.	31. Cerebral Angiography Wendell G. Scott, M.D.
18. Physics of X-radiation and Isotopes (<i>Continued from Tuesday</i>) K. E. Corrigan, Ph.D.	25. Transvaginal X-ray Therapy Arthur W. Erskine, M.D. W. Walter Wasson, M.D.	32. How to Establish and Maintain a Medical Isotope Laboratory Richard H. Chamberlain, M.D.
19. Roentgen Therapy in Cancer of the Hypopharynx and Larynx Ralph M. Caulk, M.D.	26. Cancer of the Male Genital Tract Milton Friedman, M.D.	33. Radiation Therapy of Nasal Accessory Sinuses and Nasopharynx Franz Buschke, M.D.
20. Diseases of the Chest in Infants and Children John F. Holt, M.D.	27. Acute Diseases of the Chest Aubrey O. Hampton, M.D.	34. The Chest in Industry Eugene P. Pendergrass, M.D.
21. Roentgenological Findings in Bone Diseases (<i>Continued Thursday</i>) I. Snapper, M.D.	28. Roentgenological Findings in Bone Diseases (<i>Continued from Wednesday</i>) I. Snapper, M.D.	35. Treatment of Cancer of the Skin and Lip Bernard P. Widmann, M.D.
22. Radiation Therapy of Cancer of the Tongue and Oral Cavity J. Samuel Binkley, M.D.	29. Radiological Examination of the Obstetrical Patient (<i>Repeated Friday</i>) Robert P. Ball, M.D.	36. Radiological Examination of the Obstetrical Patient (<i>Repetition of Course No. 29</i>) Robert P. Ball, M. D.
23. Roentgenologic Examination of the Small Intestine (<i>Continued Thursday</i>) Ross Golden, M.D. Lois C. Collins, M.D.	30. Roentgenologic Examination of the Small Intestine (<i>Continued from Wednesday</i>) Ross Golden, M.D. Lois C. Collins, M.D.	37. Fundamentals of Radium Treatment Robert E. Fricke, M.D.

thoracic cage, diaphragm, mediastinum, and lungs as viewed in the light of present-day knowledge. A brief discussion of the appearance of the normal chest at different ages, confusing normal anatomic shadows, anatomic variants, and variations due to technical factors will be included.

Course No. 21: Wednesday, 8:30-10:00 A.M.

Roentgenological Findings in Bone Diseases

I. SNAPPER, M.D.

Mt. Sinai Hospital, New York

- First day:* Hyperparathyroidism.
Osteitis fibrosa in chronic uremia.
Polyostotic fibrous dysplasia.
- Second day:* Osteomalacia and rickets.
Gaucher's disease.
Multiple myeloma.

(This course continued Thursday, Course No. 28)

Course No. 22: Wednesday, 8:30-10:00 A.M.

Radiation Therapy of Cancer of the Tongue and Oral Cavity

J. SAMUEL BINKLEY, M.D.

Tumor Institute, Los Angeles, Calif.

This course will include diagnosis and selection of the type of therapy, including surgery, for the different lesions.

Course No. 23: Wednesday, 8:30-10:00 A.M.

Roentgenologic Examination of the Small Intestine

ROSS GOLDEN, M.D.

LOIS C. COLLINS, M.D.

Presbyterian Hospital, New York

Discussion of the anatomy, physiology, and psychosomatic manifestations of diseases of the small intestine, including diseases of the mesentery, nutritional disorders, other conditions involving damage to the intramural nervous system, and neoplasms and inflammations.

(This course continued Thursday, Course No. 30)

Course No. 24: Thursday, 8:30-10:00 A.M.

Abdominal Arteriography

DAVID SHAPIRO, M.D.

Nichols General Hospital, Louisville, Ky.

- I. Historical background.
Technic.
Indications for the examination.
Possible complications and their management.
Normal roentgen anatomy.

II. Demonstrations of findings in:

1. The Leriche syndrome: clinical findings, pathology, and arteriographic findings.
2. Aneurysms of the abdominal aorta and the iliac vessels. Saddle thrombus of the aorta.
3. Renal conditions.
 - (a) Congenital lesions, such as: agenesis, horseshoe kidneys, aberrant vessels.
 - (b) Tumors and cysts of the kidney.
 - (c) Adrenal tumors.

III. Evaluation of the method.

IV. Questions and discussions.

Course No. 25: Thursday, 8:30-10:00 A.M.

Transvaginal X-ray Therapy

ARTHUR W. ERSKINE, M.D.

Cedar Rapids, Ia.

W. WALTER WASSON, M.D.

Denver, Colo.

This course will include:

- (1) Discussion of efficiency and results of transvaginal therapy.
- (2) Technics.
- (3) Measurement and methods of determining dosage.
- (4) Modifications.
 1. Exposure of a single circular field through an opaque speculum.
 2. Exposure of a single circular field through a transparent speculum (as popularized by Merritt, Caulk, and del Regato).
 3. Exposure of two adjacent or overlapping half-oval fields through a speculum transparent on its outer side and opaque on its median side (as suggested by Howard Hunt).
 4. Exposure of a rectangular field through an expanding four-bladed speculum (Ers-
kine).
 5. Three overlapping circular fields as used by Twombly.
 6. Five overlapping circular fields as used by Wasson and Bouslog, the outer fields being arranged symmetrically.
 7. Modification of the Wasson-Bouslog five-field technic in which two fields are placed at each side so that the aggregate exposed field is rectangular.

Course No. 26: Thursday, 8:30-10:00 A.M.

Cancer of the Male Genital Tract

MILTON FRIEDMAN, M.D.

New York University, New York

Correlation of clinical, pathological, and roent-



REFRESHER COURSES
THE RADIOLOGICAL SOCIETY
OF NORTH AMERICA

December 2 through December 7, 1951

PALMER HOUSE
CHICAGO, ILLINOIS

(Detach here)

SEE INSTRUCTIONS ON REVERSE SIDE AND

FILL OUT THE FOLLOWING

(Print or type) M.D.

Last Name

First Name or Initials

Street Address

City

State

CHECK THE FOLLOWING

Member R.S.N.A. ☐ Guest ☐

Resident or Graduate Student in Radiology at present ☐ Where.....

Reserve Officer on Active Duty at present ☐

Fill out, also, the enrollment diagram on the reverse side of this page

INSTRUCTIONS FOR ENROLLMENT IN REFRESHER COURSES

Read the accompanying description of the courses and plan of presentation. Register early; the number admitted to each course will be limited by the seating capacity of the rooms. Reservations will be made in the order of the receipt of request.

Courses are limited to the medical profession (M.D.'s), including graduate students and residents in Radiology, and to radiation physicists.

Tickets on reservations received prior to Nov. 25 will be mailed to you. After that date they will be held for you at the Registration Desk at the Palmer House.

FEES

Members: No charge.

Non-Members: \$3.00 for each course up to maximum of \$10.00 for entire series.

Graduate students and residents in Radiology, reserve officers on active duty, and members-elect: No charge.

(Fees must accompany applications)

PLEASE INDICATE YOUR FIRST, SECOND AND THIRD CHOICES

	First Choice		Second Choice		Third Choice	
	Course No.	Instructor	Course No.	Instructor	Course No.	Instructor
Sunday, Dec. 2						
2:30 P.M.						
7 P.M.						
Monday, Dec. 3						
Tuesday, Dec. 4						
Wednesday, Dec. 5						
Thursday, Dec. 6						
Friday, Dec. 7						

Mail this order sheet to C. Edgar Virden, M.D., Chairman, Refresher Course Committee
Prior to Nov. 25, 320 West 47th St., Kansas City 2, Mo.
After Nov. 25, c/o Radiological Society of North America, Palmer House, Chicago, Ill.

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genologic findings in cancer of the male genital tract, with discussion of when, why, and how it should be treated.

Course No. 27: Thursday, 8:30-10:00 A.M.

Acute Diseases of the Chest

AUBREY O. HAMPTON, M.D.

Garfield Memorial Hospital
Washington, D. C.

1. Various types of acute pulmonary infection.
2. Pulmonary edema.
3. Aspiration pneumonia.
4. "Postoperative pneumonia."
5. Atelectasis.
6. Pulmonary embolism and infarction.
7. Acute bronchial occlusion.

Some of the more common conditions of the chest and mediastinum following thoracic surgery and esophagoscopy will also be discussed.

Course No. 28: Thursday, 8:30-10:00 A.M.

Roentgenological Findings in Bone Diseases

I. SNAPPER, M.D.

(Continued from Wednesday, Course No. 21)

Course No. 29: Thursday, 8:30-10:00 A.M.

Radiological Examination of the Obstetrical Patient

ROBERT P. BALL, M.D.

Baton Rouge, La.

The radiologic examination of the obstetrical patient will be discussed and illustrated with lantern slides and charts. Emphasis will be placed upon the purposes of the examination and the technical requirements. The concept of a volumetric ratio between the size of the fetal cranium and the passage of the birth canal will be stressed.

(This course will be repeated Friday, Course No. 36)

Course No. 30: Thursday, 8:30-10:00 A.M.

Roentgenologic Examination of the Small Intestine

**ROSS GOLDEN, M.D.
LOIS C. COLLINS, M.D.**

(Continued from Wednesday, Course No. 23)

Course No. 31: Friday, 8:30-10:00 A.M.

Cerebral Angiography

WENDELL G. SCOTT, M.D.

Washington University, St. Louis, Mo.

This course will be primarily concerned with a

demonstration of the technic and advantages of using serial exposures made on roll film by both single and biplane radiographic units. The course will include a discussion of some of the common causes leading to failures and to errors in interpretation.

Special emphasis will be placed on the value of cerebral angiograms in the recognition and interpretation of malformations of the cerebral arterial system. A series of the more common lesions will be demonstrated by lantern slides.

Course No. 32: Friday, 8:30-10:00 A.M.

How to Establish and Maintain a Medical Isotope Laboratory

RICHARD H. CHAMBERLAIN, M.D.

University of Pennsylvania, Philadelphia

This session will consider the procedure of establishing an isotope laboratory, including necessary training, personnel required, cost, instruments, maintenance, and protection.

Course No. 33: Friday, 8:30-10:00 A.M.

Radiation Therapy of Nasal Accessory Sinuses and Nasopharynx

FRANZ BUSCHKE, M.D.

Tumor Institute of the Swedish Hospital
Seattle, Wash.

Gross and microscopic anatomy of lesions originating in the nasal fossae, accessory nasal sinuses, and nasopharynx will be discussed as far as it is relevant for diagnosis and therapy.

Indications for radiotherapy vs. surgery and details of radiotherapeutic technics will be discussed, with demonstration of pertinent cases.

Course No. 34: Friday, 8:30-10:00 A.M.

The Chest in Industry

EUGENE P. PENDERGRASS, M.D.

Hospital of the University of Pennsylvania
Philadelphia, Penna.

This presentation will include discussion of the healthy chest and changes occurring in the various forms of pneumoconiosis.

The material shown will include long-time follow-up studies on silicosis, some of the benign pneumoconioses that may be misinterpreted as silicosis, and some of the more recent hazards such as beryllium granulomatosis.

As much time as possible will be given for questions and discussions. The privilege and the obligation of the radiologist in the diagnosis of the various health conditions in industry are exceedingly great, and this phase of the problem will be emphasized.

Appropriate lantern slides will be utilized.

Course No. 35: Friday, 8:30-10:00 A.M.**Treatment of Cancer of the Skin and Lip****BERNARD PIERRE WIDMANN, M.D.**

Philadelphia, Penna.

This course will deal with technical procedures in cancer of the skin and lip as well as an evaluation of the various methods of treatment which have been outlined by experienced radiologists. A mathematical formula will be presented but a wide latitude of technic and variations will be analyzed so that special deviations in the daily rate and intensity can be planned according to circumstances as well as the convenience of the patient. The program has to do with various types of radiation—contact, low-voltage (80-100 kv. ranges), high-voltage (200 kv.), and radium contact and interstitial procedures.

Considerable attention will be given to both small and so-called large or advanced and often hopeless or incurable superficial cancers. Complications with respect to bone, cartilage, eye, and late skin changes will be discussed.

If time permits some consideration will be given to the treatment of cancer of the lip and angiomas in children.

Course No. 36: Friday, 8:30-10:00 A.M.**Radiological Examination of the Obstetrical Patient****ROBERT P. BALL, M.D.***(This course is a repetition of Course No. 29)***Course No. 37: Friday, 8:30-10:00 A.M.****Fundamentals of Radium Treatment****ROBERT E. FRICKE, M.D.**

Mayo Clinic, Rochester, Minn.

Thirty years of experience in radium therapy has indicated those malignant and non-malignant conditions which respond better to radium applications than to other forms of treatment. Conditions treated with radium at the Mayo Clinic will be briefly discussed. Indications for beta and gamma irradiation will be summarized.

Interstitial, intracavitary, and external therapy will be discussed as well as biologic effects. Protection of patient and physician from stray radiation will be stressed, and new applicators will be demonstrated.



IN MEMORIAM



Photo by Trout-Ware

EDGAR P. McNAMEE

1890-1951

Edgar Paul McNamee, M.D., former President of the Radiological Society of North America, died in St. Alexis Hospital, Cleveland, Ohio, on July 8, 1951, after a week of illness from a heart ailment.

"Mac," as he was known to his many friends, was born in Butler, Penna., in 1890. He was graduated from the University of Pennsylvania School of Medicine in 1913 and served his internship at the

Presbyterian Hospital, Philadelphia. In 1915 he entered general practice in Cleveland and in 1917 enlisted in the Army for service in World War I. He was commissioned First Lieutenant and was assigned to the U. S. Military School of Roentgenology, Pittsburgh. After completion of his training, he served as roentgenologist for several hospitals of the Third Division in France. Following an honorable discharge from the Army, he returned to Cleveland where, making use of his training and experience, he organized the Department of Roentgenology of St. Alexis Hospital in 1920. He continued as head of this department until his death, also carrying on a private practice.

Mac's popularity and ability are attested by his membership and activities in the organized medical groups which he served so efficiently. The following is a partial list of these.

Cleveland Radiological Society: Charter member, 1923; Secretary, 1925-26; President, 1926-27. Radiological Society of North America: Member, 1920; Board of Directors, 1944-47; President, 1949.

American Roentgen Ray Society: Member, 1929. American College of Radiology: Fellow; Vice-president, 1950. Chairman of the Commission on Legislation and Public Policy at the time of his death.

Cleveland Medical Library: Life member. Cleveland Academy of Medicine: member for fifteen years; on Board of Directors for six years.

Ohio State Medical Association: President, 1947. American Medical Association: Fellow; Member of the House of Delegates from Cuyahoga County at time of death.

He was a member, also, of Alpha Kappa Kappa Fraternity, Westwood Country Club, Cleveland Athletic Club, and Clifton Club.

Dr. McNamee is survived by his wife, Ethel Petrie McNamee. They celebrated their thirty-fifth wedding anniversary last year. She accompanied Mac on many of his travels to medical meetings and is well known to his numerous friends and colleagues for her graciousness. Also surviving are five brothers, including Hugh A., a Cleveland attorney, and Regis J., a Cleveland physician, and two sisters.

Mac was always genial and had the happy faculty of easily making friends, to whom he was most loyal. He was analytical and wise in council and not prone to hasty decisions. His untimely death is a great shock and a loss to all who knew him.

U. V. PORTMANN, M.D.

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ANNOUNCEMENTS AND BOOK REVIEWS

OREGON RADIOLOGICAL SOCIETY

The following newly elected officers of the Oregon Radiological Society have recently been installed: President, Arthur F. Hunter, M.D., Portland; Vice-President, John R. Seeley, M.D., Eugene; Secretary-Treasurer, J. Richard Raines, M.D., Medical-Dental Building, Portland 5, Ore.

PITTSBURGH ROENTGEN SOCIETY

At the June meeting of the Pittsburgh Roentgen Society, Dr. Lester M. J. Freedman was elected President; Dr. Joseph E. Malia, Vice-President; Dr. Newton Hornick, Treasurer; Dr. Edwin J. Euphrat, 3500 Fifth Ave., Pittsburgh 13, Secretary.

DR. JOHN D. CAMP HONORED

A testimonial dinner was given by the Minnesota and North Dakota Radiological Societies in St. Paul on July 21, honoring Dr. John D. Camp of the Mayo Clinic and his contributions to Radiology. Dr. Camp, who has been a member of the Minnesota Radiological Society for twenty-five years, is leaving the state to take up the practice of his specialty in Los Angeles.

GOLD MEDAL FOR DR. LOWELL S. GOIN

During the recent American Medical Association Meetings, Dr. Lowell S. Goin of Los Angeles was awarded a gold medal by the American College of Radiology for distinguished and extraordinary service to the College and the profession of Radiology.

In presenting the medal, Dr. C. Edgar Virden, President of the College, called attention to the fact that in the twenty-eight years of the existence of the organization this honor has been conferred but six times: upon Dr. W. D. Coolidge in 1927; Dr. H. Clyde Snook in 1928; Mme. Marie Curie and Dr. C. C. Lauritsen in 1931; Dr. Albert Soiland, founder of the College, in 1933; and Dr. W. Edward Chamberlain in 1941.

ABBOTT LABORATORIES AT OAK RIDGE

The Isotopes Division of the Atomic Energy Commission has recently announced plans of the Abbott Laboratories for the erection of a plant in Oak Ridge, Tenn., for the processing and distribution of synthetic radioisotopes to the medical profession. This is said to be the first time that private industry has, of its own initiative, gone into an Atomic Energy Commission community with the specific purpose of making use of the radioactive isotopes so readily available there.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS. By JOHN ALBERT KEY, B.S., M.D., St. Louis, Mo., Clinical Professor of Orthopedic Surgery, Washington University School of Medicine; Associate Surgeon, Barnes, Children's, and Jewish Hospitals, and H. EARLE CONWELL, M.D., F.A.C.S., Birmingham, Ala., Associate Professor of Orthopedic Surgery, University of Alabama School of Medicine; Chief of the Orthopedic Service, South Highland Infirmary; Consulting Orthopedic Surgeon to Carraway Methodist Hospital and Baptist Hospitals; Attending Orthopedic Surgeon, Children's Hospital, Jefferson-Hillman Hospital, East End Memorial Hospital, and St. Vincent's Hospital, Birmingham, Ala. A volume of 1,232 pages, with 1,195 illustrations. Published by C. V. Mosby Company, St. Louis, Mo., 5th ed., 1951. Price \$16.00.

RADIOACTIVITY APPLIED TO CHEMISTRY. ARTHUR C. WAHL, Editor, and NORMAN A. BONNER, Assistant Editor, both of Washington University, St. Louis. A volume of 604 pages. Published by John Wiley & Sons, Inc., New York, 1951. Price \$7.50.

CHILDREN'S RADIOGRAPHIC TECHNIC. By FORREST E. SHURTLEFF, R. T., The Children's Medical Center, Boston, Mass. A volume of 80 pages, with 32 illustrations and 41 tables. Published by Lea & Febiger, Philadelphia, 1951. Price \$3.75.

PROCEEDINGS OF THE FIRST CONFERENCE ON ELECTROKYMOGRAPHY, held May 25-26, 1950, in Bethesda, Md. Sponsored by the National Heart Institute. Edited by BERT R. BOONE, M.D., FREDERICK G. GILICK, M.D., RUSSELL H. MORGAN, M.D., and MORTON J. OPPENHEIMER, M.D. A monograph of 215 pages, with numerous illustrations. Published by the Federal Security Agency, Public Health Service, National Heart Institute of the National Institutes of Health. Public Health Service Publication No. 59, U. S. Government Printing Office, 1951. Price \$7.50.

TENTH SEMI-ANNUAL REPORT OF THE ATOMIC ENERGY COMMISSION, July 1951. 152 pages. Published by the United States Government Printing Office, Washington, D. C.

STUDIES ON THE HEPATIC DUCTS IN CHOLANGIOGRAPHY. Acta Radiologica Supplement 84. By OLOF NORMAN. From the Roentgen-Diagnostic Department of the University Clinics of Lund (Head: Professor Olle Olsson). A monograph of 82 pages, with 42 illustrations. Berlingska Boktryckeriet, Lund, Sweden, 1951. Price Swed. Cr. 15.

SOFT TISSUE RADIOGRAPHY. TECHNICAL ASPECTS AND CLINICAL APPLICATIONS IN THE EXAMINATION OF LIMBS. Acta Radiologica Supplement 85. By ARNE FRANTZELL. From the Roentgen Clinic of the University of Uppsala, Sweden (Royal Academic Hospital) (Chief: Professor F. Knutsson). A monograph of 104 pages, with 37 illustrations. Almqvist & Wiksells Boktryckeri AB, Uppsala, 1951. Price Swed. Cr. 20.

ROENTGEN EXAMINATION OF PLEURAL FLUID. A STUDY OF THE LOCALIZATION OF FREE EFFUSIONS, THE POTENTIALITIES OF DIAGNOSING MINIMAL QUANTITIES OF FLUID AND ITS EXISTENCE UNDER PHYSIOLOGICAL CONDITIONS. Acta Radiologica Supplement 86. By INGEMAR HESSÉN. From the Roentgen Clinic of the University of Uppsala, Sweden (Royal Academic Hospital) (Chief: Prof. Folke Knutsson). A monograph of 80 pages with 96 illustrations. Appelbergs Boktryckeri-aktiebolag, Uppsala, 1951. Price Swed. Cr. 20.

VERTEBRAL ANGIOGRAPHY BY CATHETERIZATION. A NEW METHOD EMPLOYED IN 221 CASES. Acta Radiologica Supplement 87. By STIG RADNER. From the Roentgen-Diagnostic Department of the University Clinics (Head: Professor Olle Olsson), the Neurosurgical Clinic (Heads: Docent Lars Leksell and Doctor Nils Lundberg), and the Medical Clinic (Head: Professor Haquin Malmros) of the University of Lund. A monograph of 134 pages, with 68 illustrations. Berlingska Boktryckeriet, Lund, 1951. Price Swed. Cr. 20.

TRANSIT TIME THROUGH THE SMALL INTESTINE. A ROENTGENOLOGIC STUDY ON NORMAL VARIABILITY. Acta Radiologica Supplement 88. By LARS LÖNNERBLAD, Västervik, Sweden. A monograph of 85 pages, with 32 illustrations. AB. C. O. Ekblad & Co. Boktryckeri, Västervik, 1951. Price Swed. Cr. 20.

Book Reviews

NOUVEAU TRAITÉ D'ÉLECTRO-RADIOTHÉRAPIE. L. DELHERM. Edited by Dr. R. COLIEZ, PROFESSOR A. DESGREZ, PROFESSOR P. LAMARQUE, AND PROFESSOR A. STROHL. Vol. I. Généralités physiques et biologiques. Vol. II. Système nerveux. Glandes endocrines. Os. Articulations. Sang et ganglions. Dermatologie. Vol. III. Voies

aériennes. Tube digestif. Voies urinaires. Organes génitaux. A total of 2,776 pages, with 995 figures, 11 plates, 58 tables. Published by Masson & Cie, Paris. Price 16,000 fr.

This extensive work consists of three volumes written by 114 different contributors. Volume I is devoted to generalities; it contains an excellent chapter on chronaxia and another of generalities on roentgen rays and radioactivity; other chapters in this volume are concerned with ultra-sound, ultra-violet rays, electrodiagnosis (myograms, medullograms, etc.). Volume II covers diseases of the nervous system, of the bones and joints, and of the hemopoietic system. Notable among the chapters is the one dealing with Hodgkin's disease. Volume III contains numerous chapters on diseases of the respiratory, digestive, and genito-urinary tract. The chapters on the treatment of gynecologic cancer are thorough and well documented.

There are a few pages of chronologic events with dates, listing the outstanding accomplishments in the fields of electrolysis, atomic physics, roentgen therapy, and curie therapy. Conspicuous for its absence from this chronology is the name of Henri Coutard, the French radiotherapist and scientist, whose invaluable contributions should be an object of pride to his countrymen; in contrast, a profusion of lesser workers and contributions are listed.

In France, radiology is associated with "medical electrolysis," which includes disciplines and concerns that in the United States are disseminated in the practices of physiotherapy, orthopedics, neurology, etc. This treatise contains excellent chapters on therapeutic radiology, but the American radiologist must of necessity be bewildered by the intervening chapters on a variety of other subjects ranging from hysteria and *accouchement électrique* to the treatment of constipation and spermatorrhea. In fact, the unification of the chapters on the physics of radiations, radiobiology, and clinical radiotherapy would result in greater consistency, since these are the work of a relatively small group of authors.

The chapters on the radiotherapy of cancer have a varied quality. Since this is not a treatise on cancer, the concepts of treatment are often biased on the side of irradiation. In this respect the work is the counterpart of those surgical books that deal with radiotherapy as a form of palliation. Numerous pages are devoted to radiotherapy of non-malignant conditions, including roentgen therapy for angina pectoris, irradiation of the sympathetic lumbar ganglions for dysmenorrhea, as well as for endarteritis obliterans, etc.

These three volumes contain a great amount of valuable basic information that should be useful in guiding the first steps of the neophyte in therapeutic radiology. There are classic chapters of value to the neurologist interested in electrodiagnosis, electric shock, and encephalography. The treatise has a definite place in the hospital library.

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RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer,* Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary,* John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary,* Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary,* William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary,* Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary,* Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary,* Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary,* Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary,* Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary,* G. A. Fricker, Sacramento Co. Hospital, Sacramento 17. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary,* L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary,* R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary,* I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary,* Charles E. Duisenberg, M.D., 300 Homer Ave., Palo Alto. Meets monthly, second Tuesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary,* Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45 January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary,* Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary,* Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary,* Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary,* Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Nelson T. Pearson, M.D., 1109 Huntington Bldg., Miami. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary,* Theodore M. Berman, M.D., 350 Lincoln Road, Miami Beach. Meets monthly, last Wednesday 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* Robert C. Pendergrass, M.D., Americus. Meets in November and with State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary,* Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer,* William DeHollander, M.D., St. John's Hospital, Springfield. Meets quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary,* Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer,* William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary,* Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Donald S. Bottom, M.D., 510 S. Kingshighway Blvd. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meets quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meets in January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Irving Schwartz, 45 E. 66th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets quarterly.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 322 Demers Ave., Grand Forks.

Ohio

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MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

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PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

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SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St., Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

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TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg., Houston 5.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 18-19, 1952, Houston.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

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UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute.

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ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, San-turce, Puerto Rico.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Contribution of Cerebral Angiography in Diagnosis. R. B. Raney and Aidan A. Raney. *California Med.* 73: 342-349, October 1950.

The subject of cerebral angiography is reviewed and illustrated by means of excellent diagrams. The technique, normal angiographic pattern, indications, and pathologic changes are discussed.

The authors use both diodrast and thorotrast as media. They consider thorotrast less irritating and productive of roentgenograms of better quality. Diodrast is believed to be preferable for introduction by direct puncture and it should also be used if repeated angiographic studies are to be done, in order to avoid accumulation of thorotrast in the reticulo-endothelial system.

The use of an automatic film changer permitting six exposures during the circulation time allows study of the three angiographic phases, arterial, capillary, and venous.

Most intracranial disorders of an uncertain nature merit the use of angiography. Regardless of the type of lesion, if knowledge of the vascular architecture is important for surgical repair, angiography is essential. It should be performed in the presence of unexplained spontaneous subarachnoid hemorrhage and it is required for the surgical management of aneurysms, vascular malformations, arteriovenous fistulae, etc. In cases of cerebral lesions with high intracranial pressure, angiography often gives as much information as ventriculography, sometimes more, and it is a safer procedure. It may be very important in the presence of clinical symptoms simulating those of progressive cerebral thrombosis when hypertension and arteriosclerosis are not pronounced, since neoplasms often produce such a picture.

Nineteen roentgenograms; 10 drawings.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Examination of the Third and Fourth Ventricles by Means of Small Quantities of Air. B. G. Ziedes des Plantes. *Acta radiol.* 34: 399-407, October-November 1950. (In French)

Diagrams are shown to illustrate the fact that, when a small amount of air is injected and the patient is in the supine position, part of the air may be in the frontal horn and part in the temporal horn. If the patient's head is then placed in the upright position and flexed slightly, the air will collect in the middle and most superior portion of the body of the lateral ventricle. If then the patient is returned to the supine position, the air shifts to the frontal horn. If, next, the patient's head is turned, as in doing a backward somersault, the air goes through the foramina of Monro to fill the third and fourth ventricles. If, after this procedure, there is some air in the posterior fossa or spinal canal, moving the patient's head as in a forward somersault will convey the air to the subarachnoid spaces of the convexity of the brain.

Some authors have described the use of tomography in examining the third and fourth ventricles. This, however, is time-consuming and requires numerous films. By turning the head of the patient through a

small angle during the exposure, the images of the lateral parts of the skull can be blurred, sharply outlining the images of the median parts of the ventricular system.

Eight figures, including 5 roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Isolated Filling of the Posterior Part of the Third Ventricle by Air in Obstructions of the Aqueduct of Sylvius. H. Verbiest. *Acta radiol.* 34: 380-384, October-November 1950. (In French)

A method is described for filling only the posterior part of the third ventricle by air. After ventriculography by the usual method (complete filling), the patient is placed in the prone position on the table and the lateral ventricles are filled with liquid. The method of Ziedes des Plantes, in which only a small amount of air is injected, is preferred in infants with hydrocephalus or stricture of the aqueduct. In adolescents and adults especially if clinical signs indicate a tumor, total filling is preferred. This is then followed by filling the lateral ventricles with liquid as described above.

Two roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Three Angles of Incidence for the Examination of the Os Petrosum. C. Chaussé. *Acta radiol.* 34: 274-287, October-November 1950. (In French)

Three views called "incidences II, III, and IV" are described for special examinations of the petrous bone.

Incidence II is a projection in which the beam is directed through the open mouth between the posterior teeth and includes the intracranial portion of the petrous bone, the surrounding area, and the foramen magnum. This view is useful in demonstrating destructive lesions about the foramen lacerum and the internal auditory canal.

In Incidence III the beam is directed from above the orbit through the petrous bone being examined. This view demonstrates the internal and external auditory canals, the semicircular canals, antrum, aditus, vestibule, and other middle ear structures. It is indicated in the location of foreign bodies, petrous bone fractures, cases of facial paralysis, acute otitis, and especially in chronic suppurative otitis.

In Incidence IV, the forehead is placed nearest the film and then rotated in such a manner that the affected petrous bone lies at an angle of about 60° from the horizontal. The beam is directed from behind the petrous bone, so that the auditory canal and the bone are seen on a bias or half-axial view. This aids in the study of petrositis, fractures of the petrous bone, and tumors of the auditory canal.

Eleven illustrations, including 4 roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Some Anomalies of the Petrous Bone: Hyperostosis and Cholesteatoma. H. W. Stenvers. *Acta radiol.* 34: 374-379, October-November 1950. (In French)

Five cases of pathological changes in the petrous bone are presented: 1 case of hyperostosis with con-

striction of the porus, confirmed microscopically; 3 cases of cholesteatoma without otitis but with destruction of the petrous bone medially to the vertical semicircular canal; and 1 case of cholesteatoma with otitis and bone destruction laterally to the vertical semicircular canal.

Six illustrations.

Contribution to Sturge-Weber Disease. Franz Sommer. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 73: 581-585, October 1950. (In German)

The author observed a case of Sturge-Weber's disease for several years. This case showed the usual characteristics of facial nevi, contralateral hemiparesis with epileptic attacks and jacksonian convulsions, slowly progressive mental deterioration, speech defect, and eye changes consisting of angiomatic formations in the choroid and later glaucoma. Roentgenograms of the skull showed extensive unilateral calcification, the pattern being typical of hemangioma, and evidence of brain atrophy on the side involved. Calcium was deposited along the course of the pial vessels and adjacent sulci, and was considered to represent the primary pathologic change. The brain atrophy is believed to be secondary, the result of circulatory changes and failure, as there is insufficient evidence to indicate that the actual angiomatic formations could cause pressure severe enough to produce this result. Facial nevi are present along the course of the trigeminal distribution, particularly the third division. The first symptoms are often noticed during the first year of life, and the condition is slowly progressive.

The author presents one case which appeared to improve under radiation therapy in so far as the paralysis was concerned, but no effect on the intracranial calcium deposits was observed.

Two roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

THE CHEST

Roentgen Pictures of the Lungs and Diaphragm. Max Lüdin. *Radiol. clin.* 19: 300-311, September 1950. (In German)

The author has selected conditions of the lungs and diaphragm showing more or less unusual features and illustrated them by case histories, with roentgen findings.

Acute Edema of the Lungs: Two cases are presented. The first, due to mechanical causes, was in an 18-year-old patient who attempted suicide by hanging. X-ray examination twenty hours later showed soft, poorly defined, symmetrical hazy shadows bilaterally, partially mottled, extending outward from both hilar regions, the upper lung fields being involved as well as the central and lower. Toxic edema of the lungs was observed in a 29-year-old patient, who experienced cyanosis, rapid respiration, and pain in the chest twelve hours after gas inhalation. Approximately seven hours after the onset of respiratory difficulty, mottled, poorly defined submiliary shadows were demonstrable roentgenographically, confluent in places with aerated lung. Eight days later the x-ray picture had returned to normal.

Scleroderma: In a 47-year-old patient with generalized scleroderma roentgenograms revealed interstitial fibrotic pulmonary changes with heavy reticulations, submiliary infiltrations—sometimes confluent—

narrowing of the terminal vessels, and obliteration of some of the smaller vessels.

Leukemia: In a 50-year-old patient with chronic myeloid leukemia, a chest film showed mottling of larger and smaller areas, hilar thickening, and exaggeration of linear markings, suggesting a bronchopneumonic distribution bilaterally. The condition responded to roentgen therapy.

Chondroma: A 50-year-old patient with chronic myeloid leukemia had a sharply demarcated shadow of increased density just above the elevated right diaphragm. Within this were small punctate areas of calcium. The microscopic diagnosis was chondroma.

Solitary Lymphoblastoma: In a 56-year-old patient a rounded shadow 3.0 to 3.5 cm. in diameter was observed fluoroscopically in the mid portion of the left lung field. A benign infiltrate, metastasis, leiomyoma, and hamartoma were considered possibilities. Lobectomy was done, and the microscopic diagnosis was lymphoblastoma.

Lung Cyst: A 25-year-old patient had chronic cough but no fever, sputum, or weight loss. X-ray examination showed a round, sharply outlined shadow, perfectly homogeneous in density, in the mid portion of the right lung field, lying posterior to the mediastinum in the lateral view. Remaining portions of the lungs were negative. The patient died of an intercurrent infection and the lesion was found to be a lung cyst.

Bronchial Adenoma: In a 44-year-old patient with long-standing bronchitis and considerable respiratory difficulty, the roentgen appearance was almost identical with that in the previous case. A lung cyst was considered highly probable, but the histologic diagnosis was bronchial adenoma.

Fibrin Body: An irregular oval shadow demonstrable after pneumothorax suggested a diaphragmatic tumor but roentgenograms in various positions indicated that it was separable from the diaphragm and established the diagnosis.

Fibroma of the Lung: A 49-year-old patient had a well defined, sharply demarcated hemispherical shadow, which was shown by pneumothorax and tomography to be attached to the diaphragm. At operation a neurofibrosarcoma of the diaphragm was found.

Questionable Diaphragmatic Tumor: A 55-year-old patient had a round shadow demonstrable on fluoroscopy, projecting outward from the right border of the heart. In a lateral view it was seen to be in close relation to the diaphragm, but the diagnosis was not proved.

While this is a small series of cases it serves to point out the importance of multiple projections, diagnostic pneumothorax in selected cases, tomography, and correlation of x-ray findings with other observations.

Twenty-four roentgenograms; 1 photograph.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Postoperative Lung Shadows. V. Knoll. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 73: 537-546, October 1950. (In German)

Pneumonia is considered the most frequent post-operative complication, occasionally associated with multiple small abscesses which clear up under penicillin therapy. There often remains a fairly homogeneous shadow indicating atelectasis, persisting after the pneumonia has clinically resolved or independent of the pneumonic process. The original atelectatic shadow

of homogeneous density sometimes resolves very rapidly. As the atelectasis disappears, a dense horizontal irregular linear shadow is frequently seen which may be recognized as plate-like atelectasis. An unexplained rise of temperature may be present in apparently pure atelectasis without any clinical evidence of a pneumonic process.

The mechanism of postoperative atelectasis is imperfectly understood but it is believed that the mechanical theory of bronchial plugs does not explain this type of appearance, since the plugs have not been consistently observed at autopsy and because atelectasis resulting from mechanical obstruction gives more sharply defined borders and radial lines following the course of the bronchovascular markings. A more probable explanation is on the basis of reflex disturbance from operative trauma, contributory factors being the anesthetic, circulatory changes, and disturbance of respiratory physiology, especially the restriction of diaphragmatic motion. In many cases other constitutional and disease conditions may play a part.

The residual plate-like atelectasis has been noted in the lower lobes and right middle lobe, but has not been seen by the author in the upper lobes. Clinical symptoms due to this type of atelectasis are never severe.

Eight roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Middle Lobe Syndrome. Fred R. Harper, William B. Condon, and William H. Wierman. *Arch. Surg.* 61: 696-704, October 1950.

Chronic non-specific pneumonitis with atelectasis occurring in the middle lobe has been classified as a clinical entity and has been called "middle lobe syndrome." Enlargement of peribronchial lymph nodes has been a common accompaniment in these cases.

The authors reviewed their cases of chronic suppurative pulmonary disease (Department of Thoracic Surgery, University of Colorado) to see if there was a characteristic group of symptoms, pathologic picture, or roentgen shadow common to all cases of pneumonitis of the middle lobe. They were unable to find a correlated clinical and pathologic entity peculiar to the middle lobe but they did discover 26 cases in which they felt that involvement of hilar lymph nodes was directly responsible for the obstruction that resulted in chronic non-specific pneumonitis.

Of the 26 cases, there were only 8 which fell into the specific category that could be called middle lobe syndrome in that only the middle lobe was involved and the pneumonitis was non-specific. Three additional patients with the same clinical, roentgenologic, and laboratory findings as the others were found to have tuberculosis. In 6 other cases, the middle lobe was primarily involved with non-specific pneumonitis, but with involvement also of a segment of either the upper or the lower lobe of the right lung. In still another group of 9 cases, the same lesion was discovered, but the pathologic condition was situated in the upper or lower lobe of the left lung.

In all 8 cases in which the disease was confined to the middle lobe, calcified lymph nodes in the region of the right middle lobe bronchus were found. Such nodes were also demonstrable in cases of non-specific pneumonitis involving segments of other lobes.

Fourteen roentgenograms; 1 drawing.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Treatment of Primary Atypical Pneumonia in Children with Aureomycin. Report of Nineteen Cases. Charles E. Anderson, Jr. *Am. J. Dis. Child.* 80: 533-540, October 1950.

The author presents a report of 19 cases of primary atypical pneumonia. The ambiguity of the etiology of this disease, he states, is characterized by the designation recommended by the Army Epidemiological Board, namely, "primary atypical pneumonia, etiology unknown."

The diagnostic criteria are: (1) gradual onset; (2) minimal signs in the chest as compared with radiological evidence; (3) a low to normal leukocyte count and the usual bacterial flora in bronchial secretions; (4) no evidence of antibodies for recognized viral or rickettsial agents; (5) no clinical or objective improvement with sulfadiazine or penicillin; (6) possible appearance of cold hemagglutinins for human group "O" cells or agglutinins for *Streptococcus M.G.*

Until the discovery of aureomycin there was no effective therapy for primary atypical pneumonia. The use of that drug has shown some gratifying results.

The 19 patients covered by the report were children all of whom fulfilled the criteria for diagnosis except serologic studies on serial serum specimens for antibodies against recognized viral or rickettsial agents and the development of cold hemagglutinins. Clinical and radiological response to treatment with aureomycin following failure to respond to either penicillin and/or sulfonamides is illustrated by 3 case histories, by a table summarizing the findings in the entire series, and by roentgenograms obtained before and after therapy. Not only was aureomycin of marked benefit but its effect was sometimes dramatic.

Six roentgenograms. NELSON E. KLAMM, M.D.
Cleveland City Hospital

Differentiation of Congenital Cysts of the Lung and Those Following Staphylococcal Pneumonia. Willis J. Potts and William L. Riker. *Arch. Surg.* 61: 684-695, October 1950.

The authors report from the Children's Memorial Hospital, Chicago, 6 cases of congenital lung cyst and 3 cases of staphylococcal pneumonia which at some time during the illness simulated lung cyst.

The main causes of radiolucent areas in the lungs of infants are congenital lung cysts and acquired cysts or pneumatoceles following a respiratory infection. The authors found that staphylococcal pneumonia is the commonest cause of radiolucent areas in the lung during infancy. Differentiation between congenital and acquired lesions is important because treatment of the former is surgical while pneumatoceles formed during the course of respiratory infections usually disappear under conservative management.

The history may be of value in distinguishing between congenital and acquired lesions. A radiolucent area is very likely an acquired cyst or pneumatocele if there has been a history of staphylococcal pneumonia or other severe respiratory illness. Congenital cysts are rarely infected during infancy.

The presence of a cystic cavity before any respiratory infection has occurred is almost certainly diagnostic of a congenital cyst. A normal roentgenogram before onset of a respiratory illness, and subsequent appearance of a cyst would be diagnostic of the acquired type. The usual course of events in a case of staphylococcal pneumonia is initial consolidation followed by the

appearance of "air bubbles," then resolution and formation of a pneumatocele.

Congenital cysts remain constant in size while pneumatoceles may fluctuate rapidly. The walls of congenital cysts may be thicker. As the children get older, infection becomes more frequent in the case of congenital cysts while it is rare in the case of pneumatoceles.

Thirteen roentgenograms; 2 tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Case of a Contusion to the Thorax with Hamman's Syndrome and Subsequent Pneumonia, as a Contribution to the Subject of Pneumonia due to Contusion. A. Abplanalp. Schweiz. med. Wchnschr. 80: 1139-1143, Oct. 21, 1950. (In German)

A forty-five-year-old male sustained a contusion to the left side of the thorax with a radiographically proved fracture of the seventh rib and a small amount of effusion in the left costophrenic angle. Two hours after the accident marked dyspnea and slight cyanosis developed and the patient complained of an oppressive feeling inside the thorax. Examination disclosed the presence of signs described in American literature by Hamman as "loud, crunching or crackling sounds synchronous with the heart beat (especially systole)," indicative of the presence of a mediastinal emphysema without an accompanying subcutaneous emphysema in the neck.

Thirty-three days later the patient became seriously ill with high fever and bloody expectoration. The clinical picture was that of lung infarction, mediastinitis, or influenzal pneumonia. Films revealed streaky shadows in the region of the left lower lobe, and the diagnosis of pneumonitis with peribronchial and interstitial involvement was made.

The author gives a detailed discussion of differential diagnosis and assumes that there was an etiologic connection between the injury, interstitial emphysema, and subsequent pneumonitis.

Four roentgenograms. JULIAN O. SALIK, M.D.
Baltimore, Md.

Primary Complex of Pulmonary Tuberculosis. Alfred D. Briggs. Am. J. Dis. Child. 80: 566-577, October 1950.

This article is based on the author's observation of 142 children at St. Luke's Hospital, Chicago, with the ordinary primary complex of pulmonary tuberculosis, as determined by tuberculin testing and supplementary examinations. More than half of this number were followed for a minimum of five years, the observations including repeated physical examinations, serial roentgenograms, and laboratory studies. Cases of miliary tuberculosis, tuberculous meningitis, and the usual massive primary infections are not included in the study.

The overwhelming majority of the cases were entirely asymptomatic. The early findings on chest films were parenchymal lesions, usually multiple, which drained rapidly into the corresponding hilar nodes. The lesions gradually "hardened," with eventual calcification of 25 per cent of the peripheral lesions and 90 per cent of the hilar nodes. Two years was the average time required for the appearance of calcification in the hilar nodes.

The laboratory studies were within normal limits and gastric washings with direct examination and guinea-pig inoculations were negative in 52 cases examined. Isolation was deemed unnecessary, and treatment consisted only in removal from the source of infection.

Six roentgenograms; 4 charts.

DONALD F. MAURITSON, M.D.
Cleveland City Hospital

Clinical and Pathologic Aspects of Tuberculoma of the Lung. An Analysis of Eighteen Cases. Harrison Black and Lauren V. Ackerman. S. Clin. North America 30: 1279-1297, October 1950.

Eighteen cases of surgically removed tuberculoma of the lung are reported from the Washington University School of Medicine and Barnes Hospital, St. Louis. Six of the cases were discovered during the course of mass chest surveys, while the remainder of the patients presented themselves because of various chest complaints. Preoperative diagnosis was made in 5 cases.

Radiologically the lesions appeared as discrete solitary shadows variously situated in the lung, indistinguishable from bronchogenic carcinoma. The presence of calcium was of little help. Although histologic sections revealed calcium in 12 cases, in only 3 was this demonstrable on the films. In only 3 cases were apical infiltrates characteristic of tuberculosis present.

Pathologically, tuberculomas consist of localized areas of caseous tuberculous pneumonia in various stages of healing or progression. Although the majority of the lesions are almost completely hyalinized and quiescent, all gradations from the confluent caseous pneumonia to the calcified or hyalinized have been classified under the term tuberculoma and subjected to pulmonary resection. In all the cases reported in this series, there was persistent caseation which suggested the potential danger of sudden dissemination. Pulmonary resection is the treatment of choice.

Eight roentgenograms; 8 photographs and photomicrographs.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Results of the Boston Chest X-Ray Survey. John H. Cauley. New England J. Med. 243: 631-636, Oct. 26, 1950.

A community-wide chest x-ray survey of the city of Boston—population 750,000—was performed, covering 556,042 persons. Tuberculosis was discovered in 4,122 (0.78 per cent). Follow-up of these disclosed 247 new active cases of tuberculosis not previously known.

Numerous charts, tables, and graphs accompany the article.

I. R. BERGER, M.D.
University of Louisville

An Outbreak of Primary Pulmonary Coccidioidomycosis in Los Angeles County, California. Morton D. Kritzer, Majorie Biddle, and John F. Kessel. Ann. Int. Med. 33: 960-990, October 1950.

The observation of a number of cases of coccidioidomycosis at Los Angeles County Hospital led the authors to review the literature and to attempt an evaluation and correlation of available data on this condition.

The most accurate procedure for the diagnosis of coccidioidomycosis is the demonstration of *Coccidioides immitis* by direct mount, culture, and animal

inoculation. In the primary pulmonary phase, however, this demonstration may be extremely difficult and skin tests and serologic tests are used more extensively for practical diagnostic purposes. Positive skin tests may usually be obtained two to three weeks after clinical onset.

Eosinophilia, an increased sedimentation rate, and polymorphonuclear leukocytosis are the more constant blood findings occurring in coccidioidomycosis. In the primary pulmonary phase symptoms are varied, protean in nature, and in no way diagnostic. They are essentially those of an upper respiratory infection. Less frequent findings are joint pains, conjunctivitis, cervical adenopathy, erythema multiforme, and erythema nodosum.

Roentgenographic changes in the chest are varied and relatively non-specific. The earliest lesion is characteristically an infiltration, varying from a slight fuzzy thickening of the hilar shadows to extensive consolidations occupying a major portion of the lung field. The infiltrations vary in density from a light veil-like haze to the opacity of lobar pneumonia. Difficulty may be encountered in differentiating these from atypical pneumonia or rheumatic pneumonitis.

The lesions may clear, leaving no residue, or only a few strands, or they may progress to a protracted form in which multiple cavities are present. If these occur in the upper lobe, they may suggest tuberculosis of an advanced ulcerative type, but the majority of these lesions clear with a rapidity never seen in tuberculosis. Mediastinal adenopathy accompanies many of the severe or protracted coccidioid infections. The rapid appearance of mediastinal "lumpiness" or nodes, combined with the early infiltrative lesion, is one of the most characteristic radiologic findings. Pleural effusion is an uncommon manifestation of the primary pulmonary disease and, when present, is usually of minimal amount. Finally, calcifications, large and small, discrete and scattered, are often associated with healed coccidioidomycosis.

The transient primary pulmonary phase of coccidioidomycosis carries no mortality *per se*. It is only in the secondary or disseminated form that the death rate is high, reaching approximately 50 per cent.

The patients in the authors' series were from a group of young men in a forestry camp near Saugus, California, of whom 20 gave positive coccidioidin skin tests and 10 positive complement-fixation tests. Seven of the latter exhibited symptoms severe enough to warrant hospitalization and their histories are presented in detail. Chest films in 6 of these demonstrated the lesions usually attributed to the disease. Mediastinal lymphadenopathy and pulmonary fibrosis were the most prominent roentgen findings.

Nine roentgenograms; 2 charts; 6 tables.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Idiopathic Pulmonary Fibrosis: Its Occurrence in Identical Twin Sisters. J. Winthrop Peabody, J. Winthrop Peabody, Jr., E. W. Hayes, and E. W. Hayes, Jr. *Dis. of Chest* 18: 330-343, October 1950.

Pulmonary fibrosis, in the vast majority of cases, is a component part of a disease entity or is attributable to a definite etiological factor. Idiopathic pulmonary fibrosis is an irregular progressive pulmonary disease of unknown etiology, characterized clinically by dyspnea, chronic cough, and cyanosis. Pathologically,

there is a widespread hyperplasia of the interstitial pulmonary connective tissues. This may terminate in pulmonary insufficiency due to loss of elasticity of the lung and obliteration of alveoli, or the decrease in the pulmonary vascular bed in association with the insufficiency may lead to pulmonary hypertension and cor pulmonale. In either event death ensues.

Six cases have been reported in the literature, and to these the authors add 2 in twin sisters. In one of these sisters a persistent cough developed at the age of forty-four. Roentgenograms during the next three years showed a progressive pulmonary fibrosis which was originally thought to be due to tuberculosis. The clinical picture became worse, cyanosis developed, and death ensued three and a half years after the appearance of the first symptoms. Postmortem examination showed almost complete obliteration of all alveoli and replacement by dense, hyalinized connective tissue. The other twin began having symptoms at the age of forty-two—exertional dyspnea, easy fatigability, and increasingly severe sore throat. Three years later bouts of extreme dyspnea developed, associated with wheezing, and aggravated by paint and gasoline fumes. Roentgenograms of the chest showed a progressive fibrosis over a period of three years. All known etiological factors having been excluded, a presumptive diagnosis of idiopathic pulmonary fibrosis was made. The patient was alive at the time of the report.

The authors discuss the possibility that this condition may be an allergic manifestation, with a subclinical picture, a latent phase, and an acute final phase. They also stress the inherent constitutional tendency suggested by their cases.

Eight roentgenograms; 3 photomicrographs.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Roentgen Diagnosis of Silicosis. Eugene P. Pendergrass. *Minnesota Med.* 33: 988-998, October 1950; 1104-1112, November 1950.

Silicosis and asbestosis are the two clinically significant types of pneumoconiosis. The so-called benign types, due to the inhalation of opaque but inert dusts, without progressive fibrosis, are important mainly because they must be differentiated from silicosis.

Simple Silicosis: The characteristic silicotic lesion is a circumscribed nodule of hyaline fibrosis. The earliest lesions that are accepted by the author as evidence of simple silicosis are evident on the roentgenogram as discrete, multiple shadows of 2 to 6 mm. in diameter, more or less uniform in density, which do not disappear on examination in slight rotation. Shadows that disappear with slight rotation are likely to be vascular. The silicotic nodules are usually distributed along the vascular channels and the bronchial tree of both lungs, but at times may be limited largely to one lobe. The appearance is not characteristic. Some shadows are round, some oval, and some irregular; some are large and some small. The periphery may be ill defined, presenting a picture similar to that of military tuberculosis or generalized metastatic carcinoma. The roentgen findings should be correlated with the history and clinical data. The nodules may or may not show progressive changes.

Silicosis with Infection: The lesions of simple silicosis may be modified by infection. Associated lesions include cavities (usually thick-walled) of tuberculous origin, cavities occurring as a result of necrosis of

anemic infarcts, massive lesions, mottling, soft nodulation, various degrees of emphysema and bleb formation, pleural thickening, pleural collections, pneumothoraces and deformations of the domes of the diaphragm. The roentgenologist is rarely able to predict whether the infection is due to the tubercle bacillus or some other organism. One suspects, however, that in the majority of instances, the superimposed infection is tuberculosis.

Pendergrass believes that tuberculosilicosis is a distinct disease entity, with characteristics peculiar to itself, the result of a prolonged interaction of silicosis and tuberculosis, but differing radically from either. The so-called massive conglomerate lesions of silicosis are thought to be of this type. These may be so extensive as to destroy completely the ordinary identifying characteristics of both the tuberculosis and the silicosis, and they are invariably productive of an advanced degree of surrounding pulmonary emphysema.

Non-Specific Pneumoconiosis: A brief discussion of non-specific pneumoconiosis is included, directing attention to those mineral dusts which are incapable of stimulating within the lung the development of progressive fibrosis. Among the conditions considered are anthracosilicosis, siderosis, and reactions to cement, gypsum, and various silicates. Excessive accumulations of these inert dusts will produce only small amounts of grossly invisible cellular connective tissue. The secondary effect may be that of emphysema. Roentgenographically there may be some increase in the prominence of the linear pulmonic markings, but no specific deviations from the normal are identified.

A pseudo-nodulation may result from the inhalation of iron oxide or tin oxide. Ill-defined nodulation and/or conglomerate areas of fibrosis have been described in talc workers, but in such cases a coexistent silicosis seems probable. Corundum, an aluminum oxide of great hardness, has been described as causing lace-like granular shadows (Shaver's disease). Vanadium has been reported as causing a bronchitis and fine reticulated shadows in both lungs.

Other causes of confusing nodular densities within the lungs are tuberculosis, histoplasmosis, the mycotic infections, hemosiderosis, polycythemia vera, carcinoma, Boeck's sarcoid, and chronic pulmonary granulomatosis of beryllium workers.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Silicosis in a Large Foundry. E. Bertschi and E. Stiefel. *Schweiz. med. Wchnschr.* 80: 1163-1166, Oct. 28, 1950. (In German)

Apart from silicosis in sand blasters, the type of the disease (sidero-silico-anthraxis) seen in foundries is not so serious and incapacitating as that encountered in miners, for example. Five cases of silicosis with subjective symptoms were found in the last three years in a large foundry, and this prompted the authors to survey all 622 employees with the exception of the sand blasters. An extensive history was taken on each case, and the findings were classified according to the Johannesburg terminology adopted in the year 1930; Stage 0-1, recognizable pre-silicotic changes; Stages 1, 2, and 3, silicotic involvement of the lungs.

The examinations disclosed that 146 workers or 23.5 per cent showed changes in the lungs, of which 8.8 per cent were of Stages 1 to 3. The authors describe in detail the various types of work performed by the employees of the foundry and in two tables show the age

distribution, length of exposure to dust, and incidence of roentgenologically recognizable disease according to the type of work performed. Because of the fact that the workers were not segregated, some were affected with mixed-dust silicosis, although they were not engaged in work which would produce it, and for these reasons an exact history was necessary.

The incidence of concurrent tuberculosis was negligible; in 321 workers who died between 1927 and 1941, only 4 cases of tuberculosis were found. In the surveyed 622 cases no evidence of active pulmonary tuberculosis was noted.

The authors conclude that the finding of 23.5 per cent silicosis on roentgenographic examination, without any subjective complaints or impairment of efficiency, is very significant, as it has usually been assumed that positive findings of silicosis in foundry workers imply a diminution in performance.

As preventive measures, certain changes in the structural arrangement of the foundry are discussed. All workers showing Stages 1 to 3 are being checked at yearly intervals; those with less than fifteen years of exposure or those whose work necessitates contact with excessive amounts of dust are checked every two years, and the remainder once every five years.

Two tables; 1 graph. JULIAN O. SALIK, M.D.
Baltimore, Md.

Value of Roentgen Examination in the Diagnosis of Bronchogenic Cancer. P. Flemming Møller. *J. Faculty Radiologists* 2: 102-117, October 1950.

The author stresses the all-important role of roentgenography in the diagnosis of bronchogenic cancer. Atelectasis in most cases leads one to suspect the condition, although this is not always the first sign. Bronchial stenosis is usually the earliest effect of a neoplasm, but slight narrowing of the bronchus may exist without atelectasis or any other abnormality demonstrable on an anteroposterior film. In such cases inspiration and expiration films may disclose a diminished aeration on the affected side, or there may be a localized emphysema. Lateral views are of utmost importance. Bronchoscopy and biopsy or smear are valuable aids. Of the special roentgenologic tools, tomography and bronchography are of great importance.

Illustrative case reports are presented. Some of these demonstrate the value of tomography in showing bronchial constriction when visibility is hampered by massive atelectasis or fluid. Others serve to emphasize the value of bronchography not only in demonstrating occluded bronchi beyond the reach of the bronchoscope, but also in differentiating conditions such as bronchiectasis which may be confused with atelectasis due to tumor. The greatest difficulty is encountered in tumors of peripheral situation, in which bronchoscopy, bronchography, and tomography are usually of very little help. These peripheral tumors are of varied origin, but the author states that "a striking proportion proved to be cancer" and advocates exploratory thoracotomy "as soon as possible."

Neither atelectasis nor emphysema is pathognomonic of tumor, but their presence demands further investigation without delay. In a certain number of cases diagnosis cannot be made by roentgen methods alone. In such cases thoracotomy is the only solution.

Fifty-four roentgenograms.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Primary Bronchogenic Carcinoma. A Review of 130 Cases. Thomas Lodge. *J. Faculty Radiologists* 2: 118-123, October 1950.

The author mentions the increased incidence of lung cancer and lists the prominent symptoms and their frequency. In his series not one case was without some radiological sign. He lists the chief radiologic types as: collapsing, hilar, peripheral. Consolidating and infiltrating types are less common.

The more frequent use of bronchography for demonstrating bronchial stenosis is favored. Tomography is also useful, especially in lesions of the peripheral type. These latter growths, while theoretically more operable, are prone to early metastasis by way of the blood stream, a point to be kept in mind when considering the advisability of operation in so-called "coin lesions."

Twelve roentgenograms.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Transient Pulmonary Manifestations in Rheumatoid Arthritis. Joseph Bloom and Jack H. Rubin. *Canadian M. A. J.* 63: 355-357, October 1950.

A case of rheumatoid arthritis in which pulmonary lesions were present and intimately associated with the joint manifestations is presented, with a review of four similar cases from the literature. The pulmonary lesions as described in these earlier cases and observed by the authors were of a reticulated appearance, resembling miliary tuberculosis and Boeck's sarcoid.

The patient, a female, aged 26, was ill for one year, the course of her disease being marked by successively developing pulmonary lesions, joint manifestations, and finally clearing of both the joint disease and the chest findings. During this time diligent efforts to establish a diagnosis of tuberculosis or Boeck's sarcoidosis failed.

The authors believe that these pulmonary lesions may be a kind of anaphylactic reaction, another manifestation of the systemic nature of rheumatoid arthritis.

Three roentgenograms.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

Pontocaine and Bronchography. E. Stutz. *Fort-schr. a. d. Geb. d. Röntgenstrahlen* 73: 547-552, October 1950. (In German)

Up to 1942, 33 cases of severe pontocaine poisoning had been reported in literature, most of which resulted in death. Special precautions should therefore be taken in the use of this drug in bronchography.

Pontocaine is the most generally recommended anesthetic for bronchography. When lipiodol or other heavy oils are used, it is necessary that the mucosa be anesthetized only as far as the bifurcation, but with the newer water-soluble materials (perabrodil M and joduron B) there is a cough reflex from the finer bronchial divisions, and more thorough anesthetization is necessary. Water is absorbed from the alveoli almost as quickly as though it were given by the intravenous route. Symptoms of poisoning may come on rapidly, with convulsions, spastic contracture of facial and limb muscles, and sudden loss of consciousness. Death results through respiratory and circulatory paralysis.

The lethal dose of pontocaine in the bronchial tree is considered to be in the neighborhood of 2 mg. per kg., dangerous dose, 1 mg. per kg. The author recommends

that no more than 5 c.c. of a 0.5 per cent pontocaine solution be used, with the addition of 1 drop of a 1:1000 adrenalin solution to each cubic centimeter to retard absorption. He recommends application to the throat structures with a soft cotton brush.

In the event of symptoms of poisoning, evipannatrium (sodium pentothal) is recommended for the convulsions or cramps, and oxygen, artificial respiration, caffeine, coramin, or cardiazol to combat the respiratory and circulatory depression.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Pulmonary Arteriovenous Aneurysm. G. E. Lindskog, A. Liebow, H. Kausel, and A. Janzen. *Ann. Surg.* 132: 591-606, October 1950.

The fully developed case of pulmonary arteriovenous aneurysm is characterized by cyanosis and clubbing in the presence of a normal heart, associated with radiographic evidence of a vascular tumor in the lungs. Cyanosis may, however, be absent, as in 2 of the authors' cases. It usually appears in childhood but may occur rather abruptly in adult life. Dyspnea is slight at first but may be progressive. Clubbing of the toes and fingers is nearly constant if cyanosis is present. There may be joint pain and radiographic evidence of pulmonary osteoarthropathy. Epistaxis is a common complaint. Oozing from superficial cutaneous or visceral hemangiomas has been observed. Severe to lethal hemoptysis may occur. When polycythemia is well developed, central nervous system symptoms may appear.

About 50 per cent of the reported cases displayed multiple telangiectases and discrete nodular hemangiomas of the body, emphasizing the relationship to hereditary telangiectasia of the Rendu-Osler-Weber type. The heart is usually normal in size and contour with no evidence of murmurs except in cases with terminal decompensation. The blood pressure and venous pressure are usually within normal limits. Auscultation over the site of the aneurysm sometimes reveals a continuous rough humming murmur, accentuated in systole and deep inspiration.

The erythrocyte count and hemoglobin are increased, with values as high as 11.4 million red cells and 24.9 gm. of hemoglobin. There is elevation of the total blood volume in the polycythemic cases but the plasma volume is not significantly altered. The peripheral arterial oxygen saturation is usually decreased and decreases further with exercise.

Polycythemia rubra vera is differentiated from pulmonary arteriovenous aneurysm by its occurrence in an older age group, splenomegaly, and the demonstration of abnormal cells in the circulating blood. In congenital heart disease, cyanosis appears at an earlier age and is associated with changes in the size and contour of the heart and with cardiac murmurs; radiographic evidence of vascular tumors in the lung is absent. Benign pulmonary tumors do not commonly cause cyanosis and polycythemia, but may show clubbing of the digits.

The radiographic features in the diagnosis of pulmonary arteriovenous aneurysm include the demonstration of a saccular, cirroid, or racemose cluster of sharply defined structures with homogeneous density and the demonstration of enlarged tributary vascular channels by means of conventional radiographs or, even better, by laminagraphy, which permits differ-

entiation of the arterial and venous trunks. The utilization of the Valsalva and Müller tests is helpful in demonstrating the vascular nature of the lesion. Angiocardiography shows rapid filling of the aneurysm, which usually remains opacified after the pulmonary arteries are cleared of diodrast. Since multiple aneurysms occur in many cases, it is necessary to search both lung fields.

The presence of a pulmonary arteriovenous aneurysm is an indication for surgery, even in the absence of symptoms, cyanosis, or polycythemic changes, because of the significant danger of serious or lethal hemoptysis and fatal hemothorax. When marked cyanosis and polycythemia are present there are additional hazards of cardiac and cerebral anoxia and thromboses. The extent of pulmonary tissue resected is determined by the size, number, and location of the aneurysms.

Of the 4 cases reported by the authors, 3 were treated by lobectomy with good results. The fourth case did not receive surgical treatment. The lobectomy specimens were studied following bronchovascular injections of colored vinylite plastic. In all instances, the aneurysmal sac approached the visceral pleura closely. The supplying vessels were larger in the immediate vicinity of the aneurysms than at a more proximal level, but even more proximally were of greater caliber and had thinner walls than normal. The draining veins in each case were larger than the corresponding arteries. Each aneurysmal sac was supplied and drained by more than a single artery and vein.

The high incidence of cutaneous, mucosal, and visceral angiomas in the reported cases, and the frequent occurrence of telangiectasia or recurrent epistaxis in parents and siblings, point toward the hereditary nature of these pulmonary lesions and their identification as a variant of hereditary hemorrhagic telangiectasia.

Nine roentgenograms; 4 photographs; 3 diagrams.
JACK WIDRICH, M.D.
Cleveland City Hospital

Multiple Arteriovenous Aneurysms of the Lung in Osler's Disease (Telangiectasis Haemorrhagica Hereditaria). C. Marmier and W. H. Hitzig. *Radiol. clin.* 19: 333-338, September 1950. (In German)

An unusually difficult diagnostic problem arose in the following case with regard to several rounded opaque shadows in the lung. A 46-year-old man with known hereditary hemorrhagic telangiectasia, bleeding ulcer of the tongue, severe secondary anemia, and gradual heart failure, had a marked systolic murmur in the base of the left lung field posteriorly. To auscultation the heart was normal, but roentgenographically it appeared moderately enlarged, with considerable congestion in the lesser circulation. In the right lung field two rounded, sharply outlined shadows were observed, and on the left side, just above the diaphragm, a collection of linear and mottled shadows was present in the region where the murmur was heard. The shadow in the left lung field was diagnosed as arteriovenous aneurysm, but a question arose as to those on the right, whether they might not represent metastasis from the tongue. Shadows of increased density, band-like in nature, were seen leading to the hilar regions, from each of these areas. There was little if any visible pulsation fluoroscopically. On forced inspiration (Müller test) the areas decreased, and on forced expira-

tion (Valsalva test) they became larger. On this basis, it was concluded that these shadows also represented arteriovenous aneurysms.

The irregular appearance of the shadow on the left suggested multilobular aneurysmal masses. Tomographic studies contributed definite confirmatory evidence of the solid nature of the lesions on the right and the band-like structures (vessels) extending to the hilar regions.

Radical operation was considered impossible because of the bilateral distribution. Biopsy of the tongue lesion showed ulcer on an hemangiomatous base but no carcinoma. The patient died from a brain abscess and autopsy findings confirmed the diagnosis of arteriovenous aneurysms of the lung.

Ten illustrations, including 7 roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Valvular Pulmonic Stenosis with Intact Ventricular Septum and Patent Foramen Ovale. Report of Illustrative Cases and Analysis of Clinical Syndrome. Mary Allen Engle and Helen B. Taussig. *Circulation* 2: 481-493, October 1950.

Valvular pulmonic stenosis with an intact ventricular septum occurs less frequently than pulmonic stenosis associated with a ventricular septal defect and an overriding aorta, as in the tetralogy of Fallot. In this malformation the difficulty in sending blood through the stenosed pulmonary valve leads to right heart enlargement and to functional patency of the foramen ovale, through which a venous-arterial shunt occurs. The onset of symptoms and their severity depend on the size of the opening in the pulmonary valve. Diagnosis is important because these patients have a tendency to cardiac failure following a Blalock-Taussig operation but may be greatly helped by pulmonic valvulotomy.

Three cases are presented, illustrating the clinical syndrome, which is readily explicable on the basis of the pathologic anatomy. The stenosed pulmonary valve places a tremendous load on the right side of the heart and causes difficulty in the expulsion of blood into the pulmonary artery. This leads to hypertrophy of the right ventricle and to progressive increase in the systolic pressure. Gradually the right ventricle becomes unable to empty itself completely, and the diastolic pressure within the ventricle rises. This, in turn, increases the work of the right auricle; consequently, the right auricle hypertrophies, and the pressure within it rises.

When the pressure in the right auricle exceeds that in the left auricle, if the foramen ovale is not completely sealed, it is forced open, and venous blood is shunted into the left auricle. When the volume of unoxygenated blood so shunted into the systemic circulation is sufficiently large, the level of visible cyanosis is reached. The cyanosis is at first transitory, then becomes persistent, and deepens as the patient grows older. As the volume of the venous-arterial shunt increases, polycythemia appears. The increase in the height of the hemoglobin level renders the cyanosis more intense.

The patency of the foramen ovale is the only means by which an intracardiac venous-arterial shunt can occur in this malformation.

The elevated pressure in the right side of the heart in patients with pulmonic stenosis with an intact ventricular septum eventually causes venous congestion

and enlargement of the liver, and ultimately, if the right ventricle fails, may lead to peripheral edema and ascites. The patency of the foramen ovale acts for a time as an escape valve and lessens the load on the right side of the heart. Even while the tricuspid valve remains competent, the forceful contractions of the right auricle may cause pulsation of the jugular veins and the liver.

The primary symptom is dyspnea on exertion, which is usually present from early life. It generally precedes the onset of cyanosis and is out of proportion to the latter. There is also easy fatigability, related to the slow delivery of blood to the lungs for oxygenation. The pulmonary stenosis renders it impossible for the individual to increase the pulmonary blood flow in the normal manner with exercise.

The roentgen findings are explained on the basis of the pulmonic stenosis. There is progressive enlargement of the right ventricle and the right auricle. In the left anterior oblique position the left ventricle is often displaced posteriorly by the large right ventricle; this may give the appearance of enlargement of both right and left ventricles. The alternating forceful contractions of the right auricle and right ventricle may produce a rocking effect in the anteroposterior projection. The pulmonic conus region is usually prominent, while the pulmonary arteries are normal in size or slightly enlarged. Pulsations in the pulmonary arteries are absent or minimal. The prominence of the pulmonary conus is usually due to the dilatation of the pulmonary artery distal to the valvular stenosis.

Angiocardiography demonstrates delay of dye in the right side of the heart and poor visualization of the pulmonary vascular tree. There is usually a delay in visualization of the aorta until some of the contrast medium has passed from the right auricle, through the defect in the auricular septum, to the left, and the aortic shadow is quite faint. The authors mention the danger of this procedure in patients with extreme pulmonary stenosis and impending heart failure, as the sudden injection of contrast material under pressure may add too great a load to the already overtaxed right heart. One of their patients died immediately following angiocardiography.

The malformation described here is to be differentiated from the tetralogy of Fallot, from Ebstein's anomaly of the tricuspid valve, from cor pulmonale and from the Eisenmenger complex.

Nine roentgenograms; 2 photographs.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Hemodynamic Study of a Case of Anomalous Pulmonary Venous Drainage. W. Hwang, O. Prec, K. Kuramoto, S. Segall, and L. N. Katz. *Circulation* 2: 553-557, October 1950.

Complete drainage of the pulmonary veins into the right heart is one of the rarest and most severe congenital cardiac anomalies. Roentgen studies may suggest this diagnosis if pulmonary veins enter either coronary sinus or inferior vena cava. In the case reported, right heart catheterization and angiocardiography were used and the diagnosis of persistent left superior vena cava and partial direct drainage of the pulmonary veins into the right auricle was made. It is important to differentiate this condition clinically from other types of cyanotic congenital heart disease which are amenable to existing surgical treatment.

The authors' patient was a white boy of 31 months known to have congenital heart disease. A heart murmur was noted shortly after birth, and cyanosis was present from early infancy, especially after excitement or exertion. The cyanosis had gradually increased in intensity and just prior to admission there had been marked limitation of physical activity. Examination revealed a harsh blowing systolic murmur over the whole precordium. The red blood cell count was 6,220,000, and the hemoglobin 14.0 gm. per cent.

Fluoroscopic examination showed no abnormal pulmonary vascular markings. Just below the aortic knob there was a well defined bulge in the postero-anterior view. The left anterior oblique projection showed this shadow to continue upward into the paramediastinal region. The hilar shadows were not remarkable. There was no gross over-all enlargement of the heart.

On right heart catheterization the catheter passed directly from the right atrium into a pulmonary vessel, indicating direct drainage from at least one right pulmonary vein to the right atrium. Oxygen determination on the blood from the superior vena cava showed a very high oxygen content (11.2 volumes per cent) and indicated an admixture of oxygenated blood in the superior vena cava prior to its entrance into the right atrium. This suggested that the abnormal shadows in the left paramediastinal region represented a persistent left superior vena cava draining the left lung into the right atrium *via* the superior vena cava on the right.

Angiocardiography was done, demonstrating the presence of an interauricular septal defect, which was essential for the maintenance of systemic flow.

It is generally contended that anomalous pulmonary veins causing a *partial* shunt of blood into the right heart may not give rise to any symptoms or signs, and are compatible with a normal life. Their presence may lead to grave consequences, however, when the contralateral lung with normal drainage is therapeutically obliterated (thoracoplasty, lobectomy, pneumonectomy) for some underlying pulmonary disease. It is conceivable that some of the immediate accidents following pneumothorax or other collapse therapy may be due to such anomalous drainage.

When more than 50 per cent of the pulmonary blood is shunted back to the right side of the heart, the prognosis is very grave. In spite of the vital role of the foramen ovale, this structure usually gradually closes and deprives the systemic vascular tree of oxygenated blood. The increased cyanosis as these children grow older usually indicates that either the interauricular communication is closing or physical activity has increased out of proportion to that which can be maintained by the amount of blood coming from the lung and passing through the interauricular septal defect.

Three roentgenograms; 1 table.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Roentgenologic Consideration of Myocardial Aneurysm. W. Hirsch. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 73: 525-536, October 1950. (In German)

Following a coronary accident the degree of aneurysmal involvement can never be accurately estimated, as a number of unknown factors contribute, *vis.*, the degree and extent of anastomosis, the anatomical and functional quality of the vessels, the *vis a tergo*

or power of the heart, and the manner in which the coronary closure has taken place, whether suddenly by embolus or gradually through thrombosis, mesarteritis, arteriosclerosis, etc.

Acute aneurysm may occur with sudden cardiac rupture or bulging and stretching of the muscles. Chronic aneurysm usually shows (1) a short stage of angina pectoris; (2) a stage of pericarditis associated with severe pain, fever, and pericardial friction rub; (3) a latent stage, lasting from weeks to years; and (4) a final stage of severe heart muscle damage resulting in sudden rupture or development of decompensation. The heart muscle does not regenerate, but the damaged muscle is replaced by fibrotic tissue.

The usual location is near the apex or anterior wall of the left ventricle with occlusion of the left coronary artery; a few cases are seen posteriorly. Seldom is an aneurysm observed within the right ventricle or the auricles. X-ray examination shows an out-pouching of the involved area often the size of an egg; sometimes a double profile is observed near the left border. Even with extensive aneurysm of the left ventricle, the right heart is not necessarily affected. The Valsalva maneuver is sometimes useful in demonstrating the size of the aneurysm, but the Müller procedure is contraindicated, as the retraction has been known to cause a heart rupture. Fluoroscopy or kymography often reveals no pulsation or a paradoxical impulse. Some cases show calcium deposits involving a large portion of the aneurysm. Coronary sclerosis is occasionally observed on an overpenetrated Potter-Bucky film.

Differential diagnosis entails consideration of (1) aortic aneurysm in the region of the heart area, (2) pulmonary artery aneurysm, (3) pericardiac cyst or tumor, (4) hernia or diverticulum of the pericardium, (5) mediastinal tumor or cyst, (6) loculated pleural exudate. By careful consideration of the x-ray evidence and correlation with the clinical aspects of the case, errors can practically always be avoided.

Fourteen illustrations, including 8 roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Angiocardiograms After Ligation of the Ductus Arteriosus. K. D. Keele. *Brit. Heart J.* 12: 372-376, October 1950.

Angiocardiography was done on a 5-year-old girl before and after ligation of a patent ductus. Before ligation, films taken in the anteroposterior projection showed a disk-like shadow indicating a refilling of the left pulmonary artery from the aorta. After ligation, this shadow had disappeared. In the left anterior oblique view a small eminence of the inner portion of the curve of the arch of the descending aorta was demonstrable. After operation this had increased in size and was more clearly seen, due to disappearance of the shadows of the refilled branches of the pulmonary artery.

To visualize the refilling of the pulmonary artery from the aorta, a relatively small amount of contrast substance must be injected very rapidly to avoid continuous filling of the right side of the heart.

Since the dilatation of the aorta increased after ligation, it can be stated that its mere presence does not prove that a ductus is patent.

Six roentgenograms; 6 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Recent Advances in the Radiological Examination of Cases of Mitral Cardiopathy. R. Heim de Balsac. *J. Faculty Radiologists* 2: 134-147, October 1950.

The author has demonstrated the relationships of the heart and great vessels by means of contrast material injected in the cadaver. He suspends the body in the upright position, inflates the lungs, and injects barium sulfate into either the jugular vein or the carotid artery for visualization of the right and left sides respectively. Roentgenograms reveal components of the heart borders in the various standard projections.

Studies were made by this method in numerous subjects with and without cardiac disease and thus a mass of data was accumulated which permits interpretation of any radiologic appearance given by the heart and great vessels. Results of angiocardiographic studies in the living have been in full agreement with the author's findings.

The present paper is concerned with mitral cardiopathy, a term which is used to cover all inflammatory processes occurring in the region of the mitral valves. In this condition the chambers of the right side of the heart are of normal shape but all dimensions are increased. Changes in the left auricle are particularly significant. Normally the left auricle cannot be seen at all in the postero-anterior or left anterior oblique projections. When it enlarges, however, it bulges posteriorly and to the right and may become visible lateral to the right auricle. Becoming larger and larger, it gradually forms more and more of the right heart border until eventually it forms the whole of this border, by which time its shadow lies outside the entire length of the shadow of the right auricle. Expansion to the left is extremely rare. When it occurs, the left auricle appears at the level of the middle arc as it emerges in the angle between the heart and the left side of the great vessels. Another effect of left auricle enlargement is seen when, on extending superiorly, it encounters the bifurcation of the trachea, splaying its branches and raising and compressing the bronchi.

Soft cardiopulmonary shadows over the heart shadow and in adjacent parts of the lung are especially characteristic in cases of mitral disease, where they are signs of a disturbed pulmonary circulation. They may have the appearance of a "homogeneous structureless mist" or may show definite structure which can be analyzed on a clear roentgenogram. They are seen then to consist either of numerous soft irregular lines radiating out from the hili or forming a network of fine arborizations, or of a conglomeration of numerous soft, rounded shadows, varying in size from very fine to coarse, so that the affected parts of the lung fields give the appearance of being dotted with micronodules or nodules.

The author concludes by applying the radiologic findings in mitral cardiopathy to the problem of treatment. Each successive stage in the increase of volume of the left auricle or of other cardiac chambers indicates a more advanced stage of the disease, requiring increasingly active and more continuous treatment and a greater restriction of the patient's activities. The appearance of soft shadows in the lung fields indicates the onset of disturbances of the pulmonary circulation and the beginning of failure.

Thirty roentgenograms; 2 diagrams.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Have We a Radiographic Sign of Grave Prognosis. A Preliminary Communication. E. M. Crawford. J. Canad. A. Radiologists 1: 54-55, September 1950.

A change in the transparency of the superficial tissues of the thorax and neck, particularly the skin and subcutaneous fat, has been noted in the radiographs of the chest of cardiac patients who died some days later. It is suggested that this may be a sign of grave prognosis.

Three illustrations.

R. J. ROMER, M.D.
Baton Rouge, La.

Measurement of Volume of Dog's Heart by X-Ray: Effect of Hemorrhage, of Epinephrine Infusion, and of Buffer Nerve Section. W. F. Hamilton, Jr., Philip Dow, and W. F. Hamilton. Am. J. Physiol. 161: 466-472, June 1950.

A nomographic chart of the relation of heart shadow area to the cardiac volume in dogs is presented. The size of the heart is reduced in hemorrhage by a figure that may amount to one-fourth of the lethal bleeding volume. It is increased by epinephrine but is not enlarged by an equal hypertension produced by buffer nerve section. These changes are in the same direction as those previously seen in the intrathoracic blood volume as calculated from the dye-injection method (Hamilton, W. F., *et al.*: Am. J. Physiol. 99: 534, 1932) and are of such magnitude as to account for a great part of these latter changes.

Four illustrations.

THE DIGESTIVE SYSTEM

Leiomyoma of the Esophagus. Report of Case with Successful Resection. Wallace C. Madden and Edwin G. Olmstead. Ohio State M. J. 46: 974-975, October 1950.

Benign tumors of the esophagus are rare, leiomyoma being found most frequently. In the case reported here the tumor was large enough to cause a lateral bulging of the mediastinum to the right on an ordinary chest film. Barium swallow gave the typical signs of an intramural submucosal tumor which had caused partial obstruction. Substernal aching and dysphagia were the only symptoms. Surgical removal was successful.

In their discussion of the case, the authors state that probably the outstanding roentgen feature of these benign intramural tumors, and the one best demonstrated by their patient, is the sharp angle formed where the tumor meets the uninvolved portion of the esophagus. This is seen in the profile view and serves for the differentiation from mediastinal tumors causing pressure on the esophageal wall, in which the angle with the esophagus is not usually sharp but gentle and concave.

One roentgenogram. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Ulcers of the Posterior Gastric Wall. Enrico Benassi. Radiol. med. (Milan) 36: 801-817, October 1950. (In Italian)

The author presents numerous cases of ulcers of the posterior wall of the stomach and stresses the importance of the supine decubitus position for the demonstration of the craters. In the supine position the barium collects in the fundus and does not conceal

lesions of the posterior wall. This technical procedure has been stressed many times, by several authors, but is still too infrequently used.

Sixty-eight roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Inguinal Herniation of Stomach. Case Report. Tom F. Lewis and Paul S. Ross. Ohio State M. J. 46: 987-988, October 1950.

A case is reported of huge bilateral inguinal hernias which had been present for forty-nine years (onset at twenty years of age) and of the same size (about as large as a football) for twenty years. A gastro-intestinal study showed an elongated ptotic stomach, with the angle, pylorus, and duodenal cap in the right sac and numerous loops of small bowel in the left one. [The relation of the colon is not stated. Apparently a barium enema study was not done.]

Successful repair was carried out and postoperative examination showed the stomach normal in position and size.

Two roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Motility of the Small Intestine in Various Diseases. M. Fóti. Fortschr. a. d. Geb. d. Röntgenstrahlen 73: 603-611, October 1950. (In German)

The author's study of small intestinal motility is based on observations of 4,000 patients; 800 were followed over a period of three years in another hospital, and 148 of these came to operation. Two tables show the relationship between diagnosis and motility in the larger series and in the 148 operative cases.

For the motility studies, 200 gm. of contrast material was dissolved in 0.3 liter of spring water and 40 gm. of butter was added, the mixture being heated and stirred to a perfect homogeneity. When the head of the meal reached the cecum at two hours, motility was considered normal.

In general the observations were as follows:

Ulcer of the Small Intestine: Motility retarded, with return to normal on healing. The ileocecal valve, like the pyloric mechanism, acts through reflex spasm to obstruct the passage of the test meal. With perforation, motility is increased.

Resection of the Stomach: Increased motility post-operatively, with individual filling of the small intestinal loops (spastic), followed by delayed motility (possibly a fatigue reaction) and subsequent return to normal. The length of the individual periods varies, but is usually three to six months.

Gallbladder Disease: Increase of motility except in the presence of an obstructing calculus, when there is a notable decrease. For the gallbladder studies, the contrast material was prepared with bile, which has no effect on small intestinal motility but produces a mild laxative effect in the colon. In acute and chronic cholecystitis, the synergism between pylorus and ileocecal valve is lost; the pylorus is spastic and the ileocecal valve slack.

Gastric Hyperacidity: Decrease of motility but not in proportion to the degree of acidity or amount of secretion.

Gastric Anacidity: A measure of increase in motility, especially in chronic cases, though this was not uniformly observed.

Carcinoma: Conflicting observations, possibly due to mechanical factors incident to growth of the tumor. Motility was increased in 46 per cent of the author's cases; unchanged in 30 per cent; reduced in 24 per cent.

Thyroid Disease: No changes unless the basal metabolism rate was elevated, in which case motility was increased.

Diabetes: No change in motility in mild cases (blood sugar under 200 mg. per cent); moderate increase in severe cases.

Appendicitis: Reduced motility in both acute and chronic cases, with return to normal postoperatively.

Renal and Ureteral Stones: Decreased motility during active stages of spasm, returning to normal as symptoms cleared up.

Tuberculous Peritonitis: Decreased motility in cases not involving intestines.

Nervous Diseases: The author cites the report of Hodges *et al.* (*Radiology* 49: 659, 1947) on intestinal dysfunction associated with neurologic disease. He himself followed 6 cases of tabes and 2 of multiple sclerosis, observing reduced motility in all.

In all of the above conditions age, chronicity, and associated disease conditions serve more or less to modify the observations. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Problems in Diseases of the Small Bowel. Clinical Picture of Unusual Cases of Diseases of the Small Bowel. M. A. Spellberg and Edward L. Jackson. *Gastroenterology* 16: 425-439, October 1950.

The mesenteric portion of the small bowel is less commonly diseased than other portions of the gastrointestinal tract and the diagnosis and classification of its diseases are relatively more difficult.

Four cases of small bowel disease of interest are presented: a chronic small bowel ileus extending over a two-year period, which was thought to be due to degeneration of the myenteric plexus; a case of Boeck's sarcoidosis of the jejunum and ileum; 2 cases of regional enteritis.

While regional enteritis is being more widely accepted as a definite pathological entity, it is still not always possible to make a differentiation between regional enteritis, tuberculosis, and Boeck's sarcoidosis. The relation between regional enteritis and ulcerative colitis is obscure and requires elaboration, and the question of effective therapy in regional enteritis is still unsettled.

Four roentgenograms; 3 photomicrographs.

EDSEL S. REED, M.D.
University of Louisville

Seven Cases of Barium Carbonate Poisoning. Geoffrey Dean. *Brit. M. J.* 2: 817-818, Oct. 7, 1950.

Seven patients were mistakenly given barium carbonate instead of barium sulfate for gastro-intestinal x-ray studies. Pure barium carbonate is a white powder exactly similar in appearance to barium sulfate and is commonly used as a rat poison. It had been placed by mistake in the barium sulfate container and had been dispensed as barium sulfate to the radiologist. Although the dose administered in all cases was many times that usually considered lethal, only one patient died. In this case barium administration was followed by heavy sedation and an anesthetic, which delayed

vomiting and purging. In the other cases the large amount of barium carbonate administered caused rapid onset of vomiting and diarrhea, which may account for recovery where a smaller dose might have been fatal. Magnesium sulfate proved an excellent antidote. The symptoms were remarkably constant and all of them could be attributed to direct action on muscle. There was no evidence of any effect on the central nervous system.

Radiographic Studies of Duodenum and Jejunum in Man. J. W. McLaren, G. M. Ardran, and J. Sutcliffe. *J. Faculty Radiologists* 2: 148-164, October 1950.

The authors use a method of rapid serialography for recording movements of the duodenum and jejunum. They analyze over 100 examinations of 30 healthy volunteer medical students, in which exposures were made on 5-inch-square films at the rate of 2 per second for a period of twenty seconds. No subject received a total dose of more than 50 r.

A great variety of movements are seen in the normal duodenum and jejunum. The authors list the principal types as: (1) non-progressive segmentation, (2) progressive segmentation, (3) rush peristalsis, (4) ring contractions, and (5) intrinsic mucosal pattern changes. They regard the so-called "pendular movements" as a form of non-progressive segmentation.

This study represents a step in objectifying some of the normal fluoroscopic findings in the gastro-intestinal tract. The work is well illustrated and should be useful for reference.

Fifty-six roentgenograms; 3 drawings.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Duodenal Ulcers Simulating Prepyloric Lesions. Alice Ettinger. *Am. J. Roentgenol.* 64: 603-609, October 1950.

The differentiation of prepyloric lesions from duodenal ulcer is important because of the fact that treatment of the former is surgical, while the latter may be treated medically. The essential diagnostic point consists in identifying the pylorus. The author describes two causes of confusion in the roentgenological differentiation of these lesions:

(1) *Excessive foreshortening of the lesser curvature side of the duodenal bulb.* The constriction deformity of the duodenal bulb is erroneously identified as pylorus. Because of retraction, the true pylorus is eccentrically placed.

(2) *Pyloric insufficiency.* The pylorus is not localized because of gaping of the pyloric valve and is falsely placed at the site of the duodenal deformity.

Three illustrative cases are reported.

Ten roentgenograms; 2 drawings.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Perforation of Duodenum by Ingested Foreign Body. Symptoms Suggesting Disease of the Hip. James B. Gillespie. *Am. J. Dis. Child.* 80: 600-605, October 1950.

A case of perforation of the duodenum by an ingested bobby pin with associated symptoms suggesting disease of the hip in a girl twenty-four months of age is presented. The bobby pin had broken in two pieces,

each of which perforated the lower part of the duodenum into the psoas muscle. The resultant inflammatory process in the muscle produced symptoms of pain in the right hip and a limp. The foreign bodies were found to be embedded in a granuloma when they were removed about two and a half months later.

Brief reports of three other patients, all younger than the above, illustrate the usual benign nature of ingested foreign bodies. In each case the ingested body (a bobby pin) was passed uneventfully within three days.

Two roentgenograms; 1 photograph.

SHOZO IBA, M.D.
Cleveland City Hospital

Gastrojejunalic Fistulas. Postoperative Complications in Nineteen Cases. Anton W. Skoog-Smith, George Jaspin, and Joseph V. Sullivan. *Surg., Gynec. & Obst.* 91: 447-454, October 1950.

The authors studied 19 cases of gastrojejunalic fistula following surgical procedures performed for the relief of duodenal ulcer at the New York Hospital-Cornell University Medical Center. This complication most often follows posterior gastroenterostomy in males. Its seriousness lies in the fact that it leads to a rapid nutritional deficiency which renders the patient a poor operative risk and accounts for a high mortality.

A gastrocolic fistula should be suspected in a patient in whom diarrhea, weight loss, pain, vomiting, fetor oris, and bleeding develop following operation for duodenal ulcer.

The barium enema offers the most accurate means of diagnosis. In all of the present series, the lesion was thus demonstrated. A gastro-intestinal series was only 45 per cent accurate.

An extensive operative procedure is necessary to eradicate the lesion.

Three of the authors' cases are reported in detail, while the remaining 16 are presented in tabular form.

Five roentgenograms. JACK EDEIKEN, M.D.
University of Pennsylvania

Crohn's Disease. A Survey of the Literature and a Report on 34 Cases. George Armitage and Michael Wilson. *Brit. J. Surg.* 38: 182-193, October 1950.

The authors discuss the clinicopathological features of a series of 34 cases of "Crohn's disease" from the Leeds General Infirmary (Yorkshire). The terminal ileum was involved in 30 cases and the jejunum in 1. Lesions were found in the colon in 13 cases but in only 2 were these isolated. "Skip" areas, with intervening normal bowel, were observed in 15 per cent of the patients.

Though some writers have suggested that an acute regional ileitis may represent an early stage of Crohn's disease, it seems unlikely that this is so. Actually the process would appear to be insidious from the beginning. In the fully developed form, the involved segment of bowel presents a thickened, rigid, turgid wall with a "hose-pipe" appearance. The transition to healthy bowel is usually abrupt.

Four clinical types have been described and all are represented in the authors' series.

(1) *Acute Intra-abdominal Disease with Peritoneal Irritation* (10 cases): In most of these cases, while the acute and severe symptoms were of short duration, there was a history, dating back months or years, of

occasional vague abdominal discomfort, colicky pain, or loose stools. The acute syndrome is almost indistinguishable from appendicitis, consisting typically of low fever, colic, vomiting, and pain and tenderness in the right iliac fossa, with sometimes a palpable lump and diarrhea.

(2) *Symptoms of Ulcerative Enteritis* (10 cases): In this group, diarrhea is a prominent feature, usually with loss of weight and anemia. Blood is frequently present in the stools. This is the group in which internal fistulae are most likely to be found and in which the prognosis is most serious.

(3) *Stenotic Group* (11 cases): With stenosis, pain is the predominant finding, periodic and cramp-like, with occasional nausea. The symptoms may be of long duration without loss of weight or obvious ill health. Examination may reveal a lump in the right iliac fossa.

(4) *Persistent and Intractable Fistulae* (3 cases): Fistulae are usually internal but 2 of the authors' patients had spontaneous external fistulae.

Pain was present in all the cases of the series; diarrhea in 70 per cent; some loss of weight in slightly less than 50 per cent. In most instances the duration of the illness was measured in years rather than in months or weeks.

Roentgen study gives highly accurate results in this condition. A correct preoperative diagnosis was obtained in all cases submitted to barium meal study and "follow-through" examination. Kantor's string sign is well known. In addition, there are ileal stasis and dilatation above the lesion, depending upon the degree of stenosis. Fistulae may be demonstrated.

One-stage resection was done in 20 uncomplicated cases in this series, with recurrence in 4. A few cases had side-tracking operations or two-stage resections. The over-all mortality rate was 18 per cent; the recurrence rate in resected cases, 20 per cent.

Seven illustrations in color; 4 photomicrographs; 1 roentgenogram; 4 tables. I. R. BERGER, M.D.
University of Louisville

Intussusception in Infancy and Early Childhood. A Ten Year Review of the Cases at the Doernbecher Memorial Hospital for Children. Millard S. Rosenblatt and Hugh D. Colver. *West. J. Surg.* 58: 553-560, October 1950.

The authors report a series of 51 cases of intussusception in children, all undergoing laparotomy between 1939 and 1948. There were 5 fatalities (9.8 per cent), but in the last three years no deaths had occurred in 22 consecutive cases. (To this latter number 4 were added after completion of the study.)

The possible etiologic factors are discussed, and it is pointed out that in at least 51 per cent of the cases there was a coexisting mesenteric lymphadenitis. A seasonal peak of intussusception (68 per cent) as well as of mesenteric lymphadenitis (92 per cent) was observed between November and April.

The first year of life provided the largest number of cases in the series, and all fatalities were in this group.

The typical symptom complex includes intermittent abdominal pain, vomiting, bloody stools, palpable mass, obstipation, and shock. It is emphasized that, though blood in the stool is almost pathognomonic, diagnosis should not be delayed by its absence. Only 49 per cent of the authors' cases showed grossly bloody stools.

The barium enema is an extremely valuable diagnostic aid, and the typical findings of meniscus sign, coiled spring pattern, and obstruction to flow of barium are well illustrated. The barium enema may also aid in partially reducing the intussusception, but this should be done cautiously. Laparotomy is justified even in cases where the intussusception has been apparently completely reduced by the enema.

Surgical procedures are discussed. The authors believe that appendectomy at time of reduction is justified in simple cases; it did not add to mortality or morbidity in the 20 cases in which it was done.

Three roentgenograms showing the characteristic changes are included. Two case histories are presented, illustrating possible complications. Also included are four tables and two charts, tabulating some of the clinical findings.

Three roentgenograms. HARRY FLAX, M.D.
University of Louisville

Differentiation of Diverticulitis and Carcinoma of the Large Bowel: A Roentgenologic Problem. Robert G. Fraser and Carleton B. Peirce. *J. Canad. A. Radiologists* 1: 39-47, September 1950.

The differentiation between diverticulitis and carcinoma of the distal descending colon or sigmoid is a major problem due to the similarity of clinical history and physical findings. Without a positive biopsy, the responsibility for the diagnosis rests on the radiologist.

The authors' findings are based on a series of 159 patients studied at the Royal Victoria Hospital (Montreal) during a twelve-year period. The relative frequency of the two lesions was similar, 91 patients (57 per cent) having carcinoma and 66 (42 per cent), diverticulitis. Two patients (1.3 per cent) had coincident diverticulitis and carcinoma.

Melena is of value as a differential sign, being frequent in carcinoma and uncommon in diverticulitis. Its frequency in the latter has been variously reported from 0 to 25 per cent. In the authors' series of cases gross blood in the stools was seen in a single case of diverticulitis.

The stages of diverticulitis described by Singleton and Hall (*Canad. M. A. J.* 37: 525, 1937), correlating the pathological and roentgenologic findings, are: (1) acute inflammation of the bowel wall with spasm of the circular muscle and a resultant saw-tooth pattern and tenderness on palpation; (2) fibrotic reaction causing increase in deformity, narrowing of the lumen, less spasm, local tenderness, and no definite mass; (3) thickened bowel wall with fibrosis, pericolicitis and abscess formation, a marked narrowing of the lumen, no local spasm, but often an associated spasm of adjacent bowel wall and a palpable mass.

The radiological differentiation is based on (1) the presence or absence of diverticula, (2) the mucosal pattern, and (3) the length and contour of the lesion. Most authors agree that elevation of the intracolonic pressure with widening of the hiatuses for the vessels perforating the muscle coat is one of the principal factors in the development of diverticulosis. Thus, any obstructive lesion may increase the frequency of diverticula. The absence of diverticula in the presence of a stenosing lesion of the lower bowel strongly favors a diagnosis of carcinoma. It must be borne in mind, however, that the ostium of a diverticulum may be narrowed by edema and be seen only on a post-

evacuation film or even twenty-four hours later. The character of the mucosal pattern is not altered in diverticulitis except for mild distortion by edema, while carcinoma characteristically destroys the mucosa. The lesion is typically long with ill defined extremities in diverticulitis, and short with well defined overhanging edges in carcinoma. Scirrhus carcinoma, however, may show a conical shape similar to diverticulitis, or the adjacent bowel may show irritability and spasm due to local infection.

Difficulty in diagnosis is increased markedly when complete obstruction prevents adequate outlining of the lesion by barium. Complete obstruction is uncommon in diverticulitis, occurring in only 7.5 per cent of the authors' series.

In any suspected lesion in the region of the sigmoid, thorough roentgenoscopic study and associated detail films are imperative for correct diagnosis. In the authors' series of 159 cases, the roentgen diagnosis was confirmed in 90.6 per cent. The causes of confusion were atypical lesions and those in which some features of both diverticulitis and carcinoma were present and one aspect was stressed too strongly. Several such cases, on review, were shown to have a dearth of adequate spot detail films.

Nine roentgenograms; 2 tables.

R. J. ROMER, M.D.
Baton Rouge, La.

The Tannic Acid Barium Enema in Colonic Investigation. R. A. Kemp Harper and J. H. L. Conway-Hughes. *J. Faculty Radiologists*. 2: 168-176, October 1950.

A short history of the development of the barium enema technic is presented, with special reference to the tannic acid method. The authors are of the opinion that disappointing results with this method have been due to improper preparation of the medium.

The tannic acid technic is designed for better demonstration of mucosal pattern. It achieves this in three ways: (1) It is a powerful astringent and inhibits secretion of mucus which prevents deposition of barium. (2) The solution is viscous, which helps the barium to adhere. (3) It is irritating and thus produces contraction of the bowel permitting more satisfactory evacuation.

The authors stress preparation of the colon, preliminary plain films, careful administration of the enema with judicious use of spot-pressure films, air insufflation, and stereoscopy where indicated. Particularly important is preparation of the enema fluid. A 2.5 per cent solution of tannic acid, 200 gr. to the pint, is prepared. Barium sulfate, 8 oz. to the pint, is added to this solution, which should be at body temperature.

The appearances found in post-evacuation radiographs, with this technic, are described and illustrated under the following heads: normal mucosa, intrinsic neoplasms, extrinsic lesions, diverticula, ulcerative colitis, and polyps.

Twenty roentgenograms; one photograph.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Surgical Emphysema Following Double Contrast Enema. A Case Report. Leonard Goldberg. *J. Canad. A. Radiologists* 1: 52-53, September 1950.

The author reports a case of extensive retroperitoneal emphysema which occurred during the air insufflation

of a double contrast enema. The air extended upward into the chest wall and pleuropericardial space. The patient showed no symptoms referable to the diffuse emphysema. Digital and proctoscopic examination of the rectum revealed no abnormality.

It is recommended that air insufflation always be done during fluoroscopy so that the direction of the air can be checked and the insufflation stopped if emphysema occurs.

Two roentgenograms. C. R. PERRYMAN, M.D.
Baton Rouge, La.

Roentgen Examination in Mesenteric Thrombosis. J. Frimann-Dahl. *Am. J. Roentgenol.* 64: 610-616, October 1950.

The roentgen appearance of mesenteric thrombosis varies according to the site of the thrombosis and the extent of the intestinal infarct, and depends also upon how early the patient is examined.

Distended loops of bowel have been demonstrated radiographically as early as three or four hours after onset of symptoms. Nearly all cases show the common feature of distended small intestinal loops containing gas and fluid levels. The first impression gained may be that of a simple mechanical obstruction. The number and size of distended loops may increase markedly in the course of a very few hours. Such a rapid increase usually does not occur in simple mechanical obstruction. The single loops are not as definitely hoop-shaped as in mechanical obstruction and are not as dilated. The mucous membrane pattern shows signs of thickening and rigidity due to edema. The folds are relatively small, standing close together, with contours irregularly serrated. If barium is given by mouth, there is marked retention of the contrast medium in the involved loops, which present stereotyped markings.

As a rule, portions of the colon are also affected in acute mesenteric thrombosis and correspondingly distended by gas. The findings may simulate colonic obstruction, and films may show distention of the colon with demarcation of the gas column abruptly halted at a certain level. Fluid levels are not as apparent in such cases as they are in the presence of mechanical obstruction. Barium enema studies show no evidence of obstruction.

The author states that in some respects the roentgen findings of mesenteric thrombosis are characteristic but they may simulate a mechanical obstruction of either the small or large bowel or an acute ileocecalitis.

Ten roentgenograms; 1 photograph; 1 drawing.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

The Solitary Gallstone. Robert S. Mechling and James R. Watson. *Surg. Gynec. & Obst.* 91: 404-408, October 1950.

Solitary gallstones, all symptomatic, were found in 82 (21 per cent) of 387 consecutive cases of cholecystitis with cholelithiasis seen in the Presbyterian and Woman's Hospitals, Pittsburgh, Penna. They occurred slightly more often in the male than in the female. Complications occurred in 41.47 per cent of the cases of solitary stone as compared with 29.84 per cent of the cases of multiple stones, the increased incidence being due almost entirely to the relatively larger number of cases of acute cholecystitis, empyema, gangrene, and

acute pancreatitis. Surgical management of the solitary stone group resulted in a mortality rate of 3.65 per cent as compared with 1.63 per cent for the multiple stones.

The only way a solitary gallstone can be demonstrated preoperatively is by cholecystography. The diagnosis is subject to error, however, since even when multiple stones are present, a solitary shadow may be seen on the roentgenogram. The demonstration of a solitary gallstone is as much an indication for cholecystectomy as is the report of multiple stones.

Five illustrations, including 1 roentgenogram; 6 tables.

J. LUTHER JARVIS, M.D.
University of Pennsylvania

Pancreatic Duct Filling During Cholangiography: Its Effect Upon Serum Amylase Levels. Carter W. Howell and George S. Bergh. *Gastroenterology* 16: 309-316, October 1950.

Retrograde flow of bile into the pancreatic ducts has been considered to be one of the possible mechanisms in the production of pancreatitis. Since elevated diastase levels may disclose pancreatitis, the authors made a study of patients with known reflux.

Their series consisted of 65 patients in whom cholangiography was performed following biliary tract surgery. Reflux of the dye into the pancreatic duct was demonstrated roentgenographically in 27 of this number. Amylase studies were done by the Somogyi modification of the Wohlgemuth colorimetric technique and levels were obtained prior to and at intervals of half an hour, eighteen hours and forty hours following cholangiography. Among the 27 patients showing pancreatic reflux 25 (83.7 per cent) had amylase levels rising above 200 units following the procedure; of the 38 patients without reflux, 37 maintained amylase levels within the limits of normal (80 to 150 units).

It would seem from this study that there is a definite correlation between pancreatic reflux demonstrated roentgenographically during cholangiography and elevation of serum amylase levels.

Four tables.

I. R. BERGER, M.D.
University of Louisville

Idiopathic Pneumoperitoneum. A Review of the Literature and Report of One Case. R. W. Ayres, C. R. Beeson, and Joe B. Scruggs, Jr. *Am. J. Digest. Dis.* 17: 345-347, October 1950.

Spontaneous pneumoperitoneum, or the appearance of free air in the peritoneal sac without demonstrable cause, while not common, has been described but its cause has never been determined. The present writers prefer to call it "idiopathic pneumoperitoneum." It should be distinguished from pneumoperitoneum where there is a known cause, such as perforated ulcer or visceral perforation.

The case cited is that of a Negro, aged 53, who was admitted to the Veterans' Hospital (North Little Rock, Ark.) because of joint pains and "stomach trouble." Episodes of epigastric pain and flatulence began about ten years before admission and had become more frequent. In 1944, the patient was treated for peptic ulcer without relief. The condition was diagnosed when he was sent to the x-ray department for a chest film and free gas was found beneath the diaphragm on either side. X-ray examination of the stomach revealed a very large stomach and deformed

duodenal cap, but there was no evidence of ulceration or perforation. The patient would not allow the gas to be aspirated and analyzed. He was treated for three months and discharged, with the same amount of gas in the peritoneal cavity. Thirty days later a scout film revealed no evidence of pneumoperitoneum.

Study of the British and American literature for the past twenty years would lead one to believe that the condition described is an unusual one. The foreign literature, however, suggests that there are many cases, due probably to a cystic disease of the intestinal tract known as pneumatosis cystoides intestinalis, in which gas is found in sacs connected with the intestine, ranging in size from that of a pea to a fist. The authors urge that this condition be sought for more closely by the surgeon and pathologist in order to determine the true etiology of idiopathic pneumoperitoneum.

One roentgenogram. JOSEPH T. DANZER, M.D.
Oil City, Penna.

THE MUSCULOSKELETAL SYSTEM

X-Ray Diagnosis and Radiation Therapy of Osteoclastoma (Benign Solitary Giant-Cell Tumor of the Bones). Zürich Experiences 1920-1949. E. Mignoli and U. Cocchi. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 73: 391-411, August 1950. (In German)

The authors report the experience of the Zürich University Radiotherapeutic Clinic in 50 patients with osteoclastoma (51 tumors) observed from 1920 to 1949. In view of the apparent confusion existing with regard to the term "osteoclastoma," the definition "benign giant-cell tumor of the bone" as given by the subtitle appears highly appropriate. [As many American textbooks now omit the term "osteoclastoma" entirely, and the definition in some medical dictionaries ("malignant myeloid sarcoma," etc.) is not only ambiguous but definitely misleading, the advisability of the further use of this designation appears debatable.—E. A. S.]

Fifty-eight per cent of the patients were females. The tumors were nearly always monostotic and monostotic and occurred principally between the ages of eleven and fifty years.

Diagnosis in the initial stages of the disease is rarely made, in part due to the absence or uncharacteristic nature of the symptoms and in part to the slight x-ray changes. Later, the so-called "soap-bubble" appearance of the bone, with relatively long areas of the cortex intact but thinned, is pathognomonic. Central forms of giant-cell tumors (mostly present in the epiphyses) and cortical forms (more frequent in the metaphyses and diaphyses of long bones) are distinguished. The period of development ranges from weeks to years. Occasionally spontaneous fractures complicate the growth and may even be the first clinical manifestation. Favorite sites of localization are represented by the distal epiphyses of the femurs, the proximal epiphyses of the tibiae, and the distal epiphyses of the radii. The prognosis is generally good, although malignant degeneration has been described.

Treatment may be purely surgical, solely by radiation, or by a combination of surgery and radiotherapy. The authors do not think that radiotherapy will cause malignant change in a giant-cell tumor, as has been claimed by some investigators. They used irradiation alone in 23 cases, surgery alone in 5, and combined therapy in 23. Their x-ray dosage varied from 2,000 r to a maximum of 13,500 r per case; the individual doses

amounted to 150 to 200 r. The treatment time ranged from twenty to fifty days. Eighty-four per cent of the cases responded well, with relief of symptoms. The five-year survival rate was 72 per cent. There were recurrences in 12 per cent. Five cases eventually showed malignant change.

Histologically, a differentiation into absolutely benign, conditionally benign, and malignant osteoclastoma is advocated. Atypical forms are, as a rule, radioresistant and must be treated surgically. Continuous after-control is necessary; recurrences generally respond well to radiotherapy. While improvement of symptoms takes place within a short time following irradiation, the regenerative osseous processes may continue over several years. Special attention is called to differentiation from non-osteogenic bone fibroma (Jaffe-Lichtenstein).

Forty-three roentgenograms; 5 photographs; 2 photomicrographs; 1 drawing; 5 tables.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

The Central Malignant Chondroma of Bone. John H. Fodden. *Canadian M. A. J.* 63: 362-364, October 1950.

Two cases of central malignant chondroma of long bones are presented and discussed. One of these lesions occurred in the ulna of a 30-year-old male, the other in the femur of a 48-year-old male. Both lesions were located at or near the middle of the cancellous shaft of the affected bone; neither showed any tendency to new bone formation. The ulnar lesion was diagnosed histologically as a malignant myxochondroma and the femoral lesion as a chondrosarcoma. Disarticulation of the affected limb was done in each case.

Two roentgenograms; 2 photographs.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

Blastomycosis of Bone. Report of a Case. Karl S. Alfred and Maxwell Harbin. *J. Bone & Joint Surg.* 32-A: 887-892, October 1950.

Mycotic infection of bone, although rare, should be considered in those cases of bone infection which are not readily diagnosed. Of the various fungous infections which involve bone, the most common are blastomycosis and coccidioidomycosis. Their source is usually the soil, which sends up delicate spores so light that they float in the air. They usually enter the lungs by inhalation.

Unlike coccidioidomycosis, blastomycosis is not an endemic disease, and its onset is more insidious. After a period of weeks or months following the unrecognized primary respiratory infection, the patient begins to have a low-grade fever, loses weight and strength, and has night sweats. A skin ulcer or subcutaneous abscess is often the first symptom suggesting fungous disease. If a subcutaneous abscess is formed by extension from an infected bone, a chronic discharging sinus may develop and persist for months or years. Mycotic infection should be suspected if chronic discharging sinuses or subcutaneous abscesses are present over varying parts of the body. The diagnosis can be substantiated by direct examination of the material obtained from the cutaneous lesions or by aspiration. A skin test may be performed with a specific vaccine.

The bone involvement is essentially in the form of destructive osteomyelitis, arising either centrally, subperiosteally, or by extension from an adjacent abscess.

Roentgenographically the bone lesions of coccidioidomycosis and blastomycosis are identical. They usually arise in cancellous bone and are predominantly destructive, with little or no periostitis, bone production, or marginal reaction. A clear-cut area of bone destruction is seen on the films. Tuberculosis presents the most confusing differential problem, but mycotic diseases seldom show joint involvement. The authors quote Carter's list of lesions directly suggestive of mycotic disease as follows: (1) those arising at such points of bony prominence as poles of patellae, acromion, coracoid processes, angles of scapulae, olecranon, styloid processes of radius and ulna, condyles of humeri, or extremities of clavicles; (2) lesions of the malleoli; (3) lesions arising in the tuberosities of the tibiae; (4) marginal solitary lesions of the ribs; (5) localized destructive lesions of the outer table of the skull; (6) destructive lesions of vertebrae, attacking indiscriminately body, processes, or neural arches.

A case is reported with destructive lesions demonstrated roentgenographically in the left innominate bone and the left ischial tuberosity. There was no bone production and practically no surrounding atrophy.

One roentgenogram; 2 photographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Vitamin D Resistant Rickets (Refractory Rickets). John F. Holt. *Am. J. Roentgenol.* 64: 590-602, October 1950.

Refractory rickets is a rare metabolic disorder of childhood which differs from ordinary infantile rickets in that huge doses of vitamin D (50,000 to 1,000,000 units per day) are required for cure and to prevent recurrences.

The blood chemistry is similar to that in infantile rickets, that is, there is normal serum calcium, low serum phosphorus, and elevated phosphatase. However, the serum phosphorus level remains persistently low in spite of intensive treatment and decreased urinary calcium excretion is not as prominent as it is in ordinary rickets. There is increased fecal excretion of calcium and phosphate.

Because of the relatively frequent occurrence of the disease in several members of a family, it is believed to be hereditary. It usually has its onset early in the post-infantile period and persists into later childhood. There is dwarfism, and severe skeletal deformities develop. The disease may stop at puberty but more often it persists into adult life as osteomalacia. Renal rickets is ruled out because blood chemistry determinations are not compatible with such a diagnosis. A diagnosis of chondrodystrophy is usually made.

Roentgenologically, the appearance is much the same as in ordinary rickets. There are generalized rarefaction and coarsening of the trabecular pattern of the bones, irregular fraying of epiphyseal plates, widening of spaces between the epiphyseal ossification centers and the shafts, and cupping of the ends of the shafts. Secondary deformities such as bowleg, coxa vara, knock-knee, and saber shin are more common and more profound than in infantile rickets, as are greenstick fractures, pseudofractures and angular de-

formities of the upper extremities. In refractory rickets, changes are more apt to occur in unusual locations, such as the angles of the scapulae, elbows, and ischio-pubic synchondroses. The lamina dura about the teeth is poorly defined or absent.

In the differential diagnosis, one must consider chondrodystrophy, osteogenesis imperfecta, hyperparathyroidism, renal rickets, de Toni-Fanconi syndrome, and late privational rickets.

The patients tolerate large doses of vitamin D, but the line between adequate control of the disease and the development of vitamin D intoxication may be very fine. Therefore, close supervision is essential.

The author reports 6 cases of refractory rickets. The first 2 occurred in siblings, and the initial diagnosis was chondrodystrophy. The present paper is believed to be the first on this subject in the roentgenologic literature.

Twenty-one roentgenograms; 1 photograph.

RODERICK L. TONDREAU, M.D.
Lincoln, Neb.

Chondrodystrophia Calcificans Congenita. Case Report with Autopsy Findings. Edward J. Coughlin, Jr., Howard T. Guare, and Abraham J. Moskovitz. *J. Bone & Joint Surg.* 32-A: 938-942, October 1950.

A case of chondrodystrophia calcificans congenita, sometimes referred to as "stippled epiphyses," is reported. The patient was an apparently premature infant. She lay with the extremities flexed, and the arms and legs could be extended only with difficulty. Films at the age of one week revealed a symmetrical distortion of the size and shape of the long bones, together with peculiar changes in the regions of the ossification centers. There were irregularly shaped, densely stippled masses in the region of all the epiphyses. The femora and humeri were abnormally short and wide, suggesting a relationship to the more common types of achondroplasia and chondrodystrophy. The infant also had a cleft palate. This is in accord with the observations of others, who have frequently reported the presence of associated congenital defects. No history of exanthemata during the early months of the mother's pregnancy was obtained, as in some cases, nor was any familial tendency noted.

While the diagnosis rests on the roentgen demonstration of stippling of the epiphyses, the authors state that the presence of flexion deformities of the extremities, as seen in their patient and in some other cases reported in the literature, may clinically suggest the condition. The child died of pneumonia at about eight weeks of age. Microscopic sections of the involved areas indicated a relationship to the general group of achondroplasia and chondrodystrophy, as suggested above.

Four roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Acro-osteolytic Manifestations of Osteomalacia. Hellmuth Kleinsorge. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 73: 471-475, August 1950. (In German)

The case is reported of a 40-year-old man who showed osteolytic changes especially involving the terminal phalanges of both hands. Similar areas of bone destruction were noted in the olecranon. The pelvis was deformed; the left clavicle showed a pathologic fracture. Marked improvement resulted from calcium and

vigantol therapy combined with ultraviolet light irradiations. The etiology of the lesions is obscure but they are believed to be due to endocrine disturbances. Symptomatically the case represents an intermediate form between typical osteomalacia and acro-osteolysis, recently described by Harnasch as a new disease entity (Fortschr. a. d. Geb. d. Röntgenstrahlen 72: 352, 1950. Abst. in Radiology 56: 303, 1951).

Seven roentgenograms; 1 photograph.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Generalized Hyperostosis and Similar Systemic Diseases of the Bones. Alfred Vogt. Fortschr. a. d. Geb. d. Röntgenstrahlen 73: 411-442, August 1950. (In German)

Four different types of generalized hyperostosis are described: (1) typical fully developed generalized hyperostosis represented by the juvenile symmetrical type, of which three stages have been recognized; (2) the adult type, symmetrical in distribution and progressing in stages; (3) the adult asymmetric type with preponderantly endosteal osteosclerosis; (4) a generalized osteosclerosis with preponderant involvement of the compact bone and polyostotic localization, incompletely symmetrical.

In the differential diagnosis, Paget's disease, osteitis fibrosa cystica, osteosclerosis associated with blood dyscrasias and Albers-Schönberg disease, Sudeck's atrophy, and dysostoses of endocrine origin must be considered. Four illustrative cases of generalized hyperostosis are presented in detail.

Fifty-eight roentgenograms; 4 photographs.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Infantile Cortical Hyperostosis. Report of a Case with Observations at Autopsy. Joseph I. Mossberger. Am. J. Dis. Child. 80: 610-620, October 1950.

A brief description of the syndrome of infantile cortical hyperostosis is presented. Acute manifestations are fever, anemia, lymphocytosis, increased sedimentation rate, and tender, brawny edema of soft tissues overlying bone. Roentgen examination shows scattered focal periosteal reactions with lamellated thickening of various bones, including the mandible, scapulas, ribs, femurs, tibiae, and fibulae.

The clinical summary of a case ending in sudden death after two and a half months is given. Roentgenograms taken postmortem showed "cortical thickening" and "hyperostotic lippling" of some of the long bones, particularly femurs and humeri. Longitudinal section of the humerus demonstrated marked thickening of the cortex, narrowing of the medullary cavity, and roughening of the epiphyseal line. Cancellous bone underlay the thick periosteum of the diaphysis. Microscopic examination revealed interruption of the epiphyseal line of ossification by strands of connective tissue containing trabeculae of cartilage and bone, running from the diaphysis into epiphyseal cartilage. Spongy bone appeared in two distinct layers, the inner contained marrow cells in its haversian spaces and a few haversian patterns in the bone itself. The outer layer of cancellous bone contained only mildly vascularized loose fibrillary tissue in its haversian spaces and showed loss of the haversian pattern in the trabeculae, which were completely covered with a layer of osteoblasts.

In his commentary on the case, the author discusses the possibility of a metabolic imbalance as the basis of this syndrome.

Four roentgenograms; 2 photographs; 5 photographs.

MILTON SEGAL, M.D.
Cleveland City Hospital

Multiple Myeloma: Two Cases Without Bony Change on Radiological Examination. Warren Smith. M. J. Australia 2: 585-588, Oct. 14, 1950.

Two cases of multiple myeloma with negative roentgenograms of the bones are presented. One was proved at autopsy. The other patient was apparently alive at the time of the report but a sternal marrow smear showed the great increase of plasma cells which is diagnostic of multiple myeloma. [It is, of course, possible that bone changes may yet develop in this case.] Bence-Jones protein was found in neither case, but examination of twenty-four-hour samples as recommended by Jaffe and Lichtenstein was not done. The cause of death in the first case was a cerebral vascular accident which occurred during supportive treatment for the myeloma. No specific therapy was used in either instance.

Four illustrations.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

A New Hereditary Skeletal Condition in the Group of Osteogenesis Imperfecta. R. Baumann-Schenker. Radiol. clin. 19: 332, September 1950. (In German)

Three cases were observed with the following symptom complex: (1) fragilitas ossium, first observed at puberty and remaining throughout life with a tendency to fissures in the small bones of the hands and feet and fractures of the long bones with no disturbance in healing; (2) roentgen evidence of generalized advanced osteoporosis, with typical changes in the skull, comprising sclerosis of the diploe and granulomatous-like rarefied areas, especially in the frontal bones; (3) an hereditary tendency in the direct line; (4) normal calcium and phosphorus metabolism with normal findings in the blood and bone marrow; bluish sclera and blue ear drums.

The above findings place the condition in the group of osteogenesis imperfecta, of which two types are recognized: (1) osteogenesis imperfecta congenita (Vrolik) and (2) osteogenesis imperfecta tarda (Lobstein). The above condition differs from the Lobstein type in that the bone changes affected the skull and onset was not until the fifteenth year.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Psoriatic Arthritis. John C. Nunemaker and Seymour A. Hartman. Ann. Int. Med. 33: 1016-1023, October 1950.

A 58-year-old peddler had skin lesions, present for twenty-five years, involving the knees, shins, elbows, scalp, and trunk. The nails were thickened and contained dead white areas and many minute pits. The fingers, with the exception of the left middle and right index, all showed sharp flexion at the terminal interphalangeal joints. The remaining joints of the hands were normal. Other peripheral joints of the extremities and the spine were entirely normal. No deformity of the toes was noted.

Biopsy of the skin lesions showed chronic, non-

specific dermatitis, with slight parakeratosis and hypertrophy of the rete. A dermatologic consultant regarded the lesions as typical of chronic psoriasis.

Roentgen examination of the lumbar spine, sacroiliac joints, and both feet was normal. In the right and left hands extensive changes were demonstrable in the distal interphalangeal joints of all fingers except the middle finger on the left and index finger on the right. The articular cartilages had disappeared, and the cortices were regular, with sclerotic as well as punched-out cystic changes at the articular margins. No significant hypertrophic changes were present.

This case presents several features which merit its inclusion with the small group of so-called "pure" cases of psoriatic arthritis in the restricted sense, *i.e.*, without rheumatoid changes. The skin lesions preceded the joint lesions by many years, and the joints involved became more painful during exacerbations of the psoriasis. In addition, the flexion deformities of the distal phalanges as seen in this patient are distinctly uncommon in ordinary rheumatoid arthritis. The only terminal interphalangeal joints involved were those in which the corresponding finger nails showed definite psoriatic changes; one finger on each hand escaped both joint and significant nail involvement.

Five roentgenograms; 3 photographs.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Vacuum Pneumarthrography and the Spontaneous Occurrence of Gas in the Joint Spaces. Dellivan M. Fuiks and Charles E. Grayson. *J. Bone & Joint Surg.* 32-A: 933-938, October 1950.

The occurrence of gas in joint spaces is not unusual. The production of low pressure in a joint by traction or disease releases gas from the adjacent tissues into the joint space, which is thus visible by contrast roentgenographically. The gas is a mixture of oxygen, carbon dioxide, and nitrogen, in proportion similar to that of the circulating blood. The authors have noted the spontaneous occurrence of this so-called "vacuum phenomenon" in the knee, shoulder, spine, sacroiliac joints, and hip joints.

No particular clinical significance is attached to the phenomenon as observed in the knee. Of 16 knees in which it was observed only 6 showed any abnormality. Vacuum pneumarthrography following forced abduction or adduction of the knee, however, may be of some diagnostic value. Absence of the vacuum space is indicative of fluid. When no fluid is present, the meniscus is demonstrable and pathological irregularities of that structure and the articular cartilaginous surface can be identified.

In the spine the spontaneous vacuum phenomenon induced by simple hyperextension will demonstrate clefts or fragments in the intervertebral disks, always in association with narrowed intervertebral spaces and hypertrophic spurs.

The authors have observed the spontaneous occurrence of a vacuum space in the hip only when the joint space was abnormal and therefore consider its presence of some diagnostic significance. The phenomenon permits the detection of minimal abnormalities of the cartilaginous surfaces not otherwise perceptible roentgenographically.

Eleven roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Skeletal Changes in Sickle-Cell Anaemia. Report of an Unusual Case. Allen E. Hamburg. *J. Bone and Joint Surg.* 32-A: 893-900, October 1950.

The sickling in sickle-cell anemia is an inherent property of the red blood cell, and is precipitated by alterations in the ratio of combined to dissociated hemoglobin. A diminution in the oxygen tension, by increasing the amount of reduced hemoglobin, produces sickling. Many of the symptoms are due to thromboses, which form from the rigid sickle-cells blocking the capillaries and rapidly ascend to larger vessels. It is postulated that the crises of the disease are due to widespread thrombosis as the capillaries become jammed with deficiently oxygenated sickle cells. Following a crisis there is a sharp fall in the red blood cell count, with a stimulus for the bone marrow to become hyperplastic and produce a new generation of cells. Whereas in non-hematopoietic tissues the changes are essentially those of congestion and thrombosis, the bones show a combination of these changes and those of bone marrow hyperplasia. This hyperplasia may occur in any cancellous bone, but is more marked in the calvarium, the long bones, and in the bones of the trunk.

The roentgen picture varies widely, from entirely negative findings in a complete bone survey to extensive osteoporotic and osteosclerotic changes. Most patients do not show skeletal changes roentgenographically.

Early reports focused attention on the skull, which was presumed, in typical cases, to show thickening of both tables, associated with spicules of bone radiating perpendicular to the flat bone, to give the "hair-on-end" appearance. The appearance is similar to that in erythroblastic anemia, but in sickle-cell anemia maximum thickening is said to occur at the vertex, whereas in erythroblastic anemia the maximum thickening is of the frontal and occipital regions. Since the finding of vertical striations is noted only rarely, it is of limited diagnostic value.

The most notable findings in the trunk are increased radiability and flattening of the lumbar vertebrae, and increase in the striations in the ribs. It is the bone marrow hyperplasia which results in osteoporosis. Osteosclerosis may develop over a period of years but is less commonly seen.

In the extremities, the tibiae and fibulae are the bones most likely to show abnormalities. The trabecular pattern is disorderly, showing peculiar curls following no particular lines of stress. Cortical thickening is usually most marked in the midportion of the shaft, and there may be thinning of the cortex at the bone ends. Often the earliest changes visible on the roentgenograms are splotchy or diffuse areas of osteosclerosis with diminution of contrast between the cortex and the medullary cavity. The abnormal striations found in the medullary cavity follow an irregular pattern, with gradual production of sclerotic bone within the area normally occupied by bone marrow. This process tends toward complete obliteration of the marrow, but only rarely has it been observed to advance to that point.

Correlation of the findings reported shows that children are more prone to have skull lesions. The non-specific changes of osteoporosis, bone widening, and cortex narrowing are found in young patients. In the adult, although the roentgenograms may be entirely negative, the changes, when present, reflect

long-standing marrow hyperplasia and infarction which produce osteosclerosis with new bone formation, thickening of the cortex, and impingement on the medullary cavity. The degree of the changes can be roughly correlated with the duration and severity of the disease.

A case is reported in a 55-year-old Negro. The bizarre roentgenograms, reproduced here, obviously represent a far-advanced, long-standing process, as indicated by the marked sclerosis and degenerative arthritis. From a roentgen standpoint, syphilis, tuberculosis, Perthes' disease, osteomyelitis, metastatic carcinoma, Paget's disease, caisson disease, were all considered in the differential diagnosis. A sternal biopsy revealed 100 per cent sickling in twenty-four hours.

Four roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Frequent Occurrence of Parosteal New Bone Formation in Transverse Paraplegia. H. Lüdeke. Fortschr. a. d. Geb. d. Röntgenstrahlen 73: 564-574, October 1950. (In German)

Parosteal new bone formation in paraplegia is morphologically identical with Steida's "accompanying shadows" (Pelligrini-Steida's disease). The author, however, found no reference in the literature to these shadows in direct association with central nervous lesion in paraplegics, the condition being generally referred to as "myositis ossificans neurotica." Lamellar bone is laid down in the soft tissues. An associated sprain, often unrecognized, with probable small hematoma formation may be contributory, followed by organization, with calcium and later bone deposit. Circulatory changes and the analgesia or anesthesia incident to the blocking of nerve impulse undoubtedly are contributory factors.

It was originally believed by some authors that the process involved the joint capsule and periosteum, but it was later found on operation and at autopsy to lie in the parosteal region and in no instance to involve the joint capsule directly. The bone is largely deposited within the tendons and sheath of the adductor magnus and vastus medialis muscles and in the tissue spaces about the joint capsule.

The author observed, in a group of 38 patients with paraplegia due to a spinal cord lesion or cerebral injury, 12 cases of abnormal bone deposit near the distal end of the femur and 9 of ossification involving the region about the hip.

Other authors mention similar conditions about the knee, elbow, and shoulder joint.

Eleven illustrations, including 8 roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Clinical Manifestations of Congenital Neurofibromatosis. H. Relton McCarroll. J. Bone & Joint Surg. 32-A: 601-617, July 1950.

An attempt is made to enumerate and describe briefly the various clinical manifestations which may be associated with congenital neurofibromatosis. In some instances a direct relationship can be proved, but in the majority of cases this has to be assumed. The frequency with which these various questionable manifestations are associated with unmistakable signs of neurofibromatosis, however, and the tissue characteristics which are found so commonly in all cases of soft-

tissue hypertrophy, represent strong presumptive evidence that all may have a common etiologic origin, namely, a primary developmental defect of the nervous system.

In a series of 46 cases, the clinical characteristics have been classified under five major headings as follows:

Type of Involvement	No. of Cases
Cutaneous	
Café au lait spots	33
Naevus lateralis	2
Verrucous type of skin hypertrophy	3
Subcutaneous	
Neurofibromatous nodules	3
Diffuse soft-tissue hypertrophy	17
Plexiform type of neurofibromatosis	3
Skeletal	
Scoliosis	19
Bone hypertrophy	14
Bone cysts	2
Congenital shortening of lower extremity	3
Congenital pseudarthrosis of tibia	5
Spondylolisthesis	4
Melorheostosis	2
Vascular	
Diffuse flat hemangioma	5
Plexiform dilatation of veins	2
Thick-walled veins in hypertrophied subcutaneous tissue	12
Lymphatic	
Edema of hypertrophied extremity	4
Dilated lymph spaces	3

Forty illustrations, including 10 roentgenograms.

Extreme Calcinosis Interstitialis. Moore Moore, Jr. and Charles L. Clarke. South. M. J. 43: 861-863, October 1950.

There are two main theories as to the etiology of calcinosis interstitialis. One maintains that calcium deposits occur in degenerated connective tissue; the other postulates an altered calcium metabolism.

There are several forms of the condition, classified mainly according to extent and general location of involvement. In general, there are two principal types, the universal and the circumscribed. The latter type is seen in older patients and predominantly in women. It is associated with vasospastic disease such as scleroderma, Raynaud's disease, or sclerodactylia in some 50 per cent of cases.

The authors report a case of unusually widespread involvement. The patient was a 46-year-old woman who six years before began to experience swelling of the skin of the entire body, cyanosis of the hands, and shortly afterward scleroderma. Later stiffness and swelling developed about both hips, the fingers, and the right shoulder. Roentgenograms revealed osteoporosis of the bones of the hands and calcium deposits in both shoulder joints, the elbows, hips, knees, ankles, and the paraspinal ligaments, in greatly varying degree. Virtually all types of calcification were present, ranging from that in isolated tendon insertion and in ligaments to massive tumoral calcinosis.

Three roentgenograms.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

The Lumbar Neural Arch. Roentgenographic Study of Ossification. George G. Rowe and Maurice B. Roche. *J. Bone & Joint Surg.* 32-A: 554-557, July 1950.

During the course of the roentgen examination of 40 children, in a study of ossification of the neural arch of the lumbar vertebrae, the authors were impressed by the roentgenographic appearance of the neurocentral synchondrosis in oblique views (45 degrees) of the lumbar spine, a finding of significance in both diagnostic and medicolegal evaluation.

The ossified pedicles and body do not fuse until between the third and sixth years. Prior to this, intervening cartilage maintains their continuity. In a study of a series of postero-oblique roentgenograms of the lumbar spine in children from three to six years of age, a line was seen to be superimposed on the neural arch, which at first raised the question of a possible separation within the arch. It was found, however, that if the outline of the neural arch were traced completely in each case, the line of diminished density could be shown to lie between the pedicle and the centrum, and, therefore, was the neurocentral synchondrosis.

Subsequent review of the whole group of roentgenograms showed that the neurocentral synchondrosis could be identified in 60 per cent of the lumbar spines studied. This is not a reliable index of its true incidence in this age group for two reasons. A slight degree of rotation of the vertebra can obscure the synchondrosis completely by superimposing the bone of the body and the pedicle on the intervening cartilage, and no attempt was made to rotate the patient at different angles to increase the number of positive demonstrations. Three-fourths of the children in this group were five years of age or older; approximately half of them presented demonstrable synchondroses, whereas those children three and four years of age presented well defined synchondroses. Hence, the younger the children in a series, the greater will be the incidence of the synchondrosis.

The synchondrosis was visualized as frequently in the sacrum as in the lower lumbar vertebrae, but the frequency of demonstration decreased steadily in each segment superior to the fifth lumbar vertebra.

The establishment of the nature of this apparent "defect" in the neural arch should dispel any misconception that might occur to the examiner of a child whose back has been the object of trauma or the source of pain.

Six roentgenograms; 1 photograph.

Longitudinal Growth of the Human Vertebra. A Contribution to Osteogeny. Edgar M. Bick and Joseph W. Copel. *J. Bone & Joint Surg.* 32-A: 803-814, October 1950.

To study the longitudinal growth of the vertebra in man, the authors took specimens from fresh autopsy material ranging from an 8-cm. fetus to a female aged twenty-three years. The sequence of specimens indicates that in longitudinal development the body of the human vertebra grows as does the diaphysis of a long bone, with true proximal and distal epiphyseal plates. Since this is so, the implication is that the body of the human vertebra is subject to the same deforming factors which influence the growth of long bones elsewhere in the body. The same diseases, dyscrasias, metabolic or endocrine disturbances, and asymmetrical pressure of posture or contractions which disturb or

retard the growth of epiphyseal plates of long bones in other parts of the skeleton are operable on the bodies of the vertebrae.

The so-called "epiphyseal ring" of the growing vertebra often observed in roentgenograms is not the actual epiphysis of the vertebral body and takes no active part in its longitudinal growth. The ring is primarily cartilaginous and ossifies separately; it is an apophysis rather than an epiphysis. For this reason the term "epiphyseal ring" should be discarded. The authors suggest, instead, the name "vertebral ring."

Fifteen photomicrographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Marie-Strümpell Arthritis. Follow-Up Study of Roentgenographic, Physical, and Orthopaedic Therapy. Lenox D. Baker, R. W. Coonrad, Robert J. Reeves, and W. A. Hoyt, Jr. *J. Bone & Joint Surg.* 32-A: 848-854, October 1950.

Over a period of nine years 568 patients with Marie-Strümpell arthritis were treated at Duke Hospital (Durham, N. C.) with roentgen rays in combination with physical therapy, active exercises, braces, and vocational training. In most instances 150 r (200 kv.) were given over fields measuring 5×15 cm. until the entire spine or area to be treated was covered. The total dose varied from 300 to 450 r in a single series to 1,200 to 1,800 r in four series. Of the 568 patients, 347 were treated four or more years before the present report, and during the six months preceding the report 100 of these were re-examined. It is this group that forms the basis for the authors' observations.

Among the 100 patients, relief of pain is described as "good" in 74, "fair" in 14, and "poor" in 12. In 80 patients in whom the range of motion was affected by the disease, 33 showed an increase in range after treatment, 24 a decrease, and 23 no change. Roentgenograms demonstrated a clearing of the process in 25; in 50 there was no further advance, and in 24 increased ossification was observed. When the cases were classified on the basis of severity, it was found that treatment can be expected to give approximately the same relief from pain in all stages; increase in range of motion can be expected in a fair percentage of the mild and moderately advanced cases, and in these two groups the process, as shown roentgenographically, can be arrested and sometimes cleared by irradiation. Roentgenographic improvement can be anticipated in the earlier cases more frequently than in the advanced cases, where the changes apparently are no longer reversible.

No satisfactory explanation for the good effect of the roentgen therapy is offered. The theory is advanced that the rays affect the chemistry of the mast cells located in the connective tissue around the blood vessels, as well as in the synovial tissues. It has been conjectured, also, that the calcification or ossification of the capsule diminishes in analogy to the effect upon calcification in bursa and tendons (Oppenheimer; *Am. J. Roentgenol.* 49: 49, 1943. *Abst. in Radiology* 41: 306, 1943). The authors conclude that, while there is no evidence that roentgen therapy affects the associated ossifying process once it is under way, it does appear to affect the cellular changes of the disease.

Six roentgenograms; 4 photographs; 2 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Spurs of the Calcaneus in Strümpell-Marie Disease. Report of Fifteen Cases. Joe B. Davis and Harry C. Blair. *J. Bone & Joint Surg.* 32-A: 838-840, October 1950.

The authors have observed that men between eighteen and thirty years of age, who present symptoms and signs of calcaneal periostitis, or spurs of the calcaneus, invariably have changes, also, of the lumbosacral spine, and of the sacroiliac joints, characteristic of Strümpell-Marie disease. [The implication of this for the radiologist is that males in this age group who are being examined for painful heels should also have other studies to exclude Strümpell-Marie disease.]

The value of roentgen therapy in Strümpell-Marie disease is well established. It will also relieve the pain of acute calcaneal periostitis, and in some cases may prevent spur formation. The dull, chronic heel pain typical of mature spurs, however, is not relieved by irradiation. This pain is caused by impingement of the suberosus bursa between the spur and the sole of the foot.

The authors had 3 patients, all eighteen years of age, with acute bilateral heel pain, and pain along the entire back, limitation of chest motion, malaise, and lassitude. Roentgen studies of the back showed typical Strümpell-Marie disease, but the heels appeared normal. In each case a diagnosis was made of acute Strümpell-Marie disease, associated with periostitis of the calcaneus. Roentgen therapy over the spine relieved not only the pain in the back, but also that over the heels.

Twelve patients between the ages of twenty-two and thirty years complained of dull pain in the heels, aggravated by weight-bearing and relieved by rest. Roentgen studies of each of the 12 showed advanced sclerosis of the sacroiliac joints and calcaneal spurs having the conformation and consistency of normal bone. In each case a diagnosis was made of "established" spurs of the calcaneus, associated with quiescent Strümpell-Marie disease. Roentgen therapy was tried in 4 cases but was without effect.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Changes in the Scoliotic Spine After Fusion. Ignacio V. Ponseti and Barry Friedman. *J. Bone & Joint Surg.* 32-A: 751-766, October 1950.

The roentgenograms of 117 cases of scoliosis—idiopathic, paralytic, and congenital—which had been treated by fusion of the spine at the State University of Iowa Hospitals were studied. In most of the patients the bone grafts appeared to be completely replaced by new bone in from three to twelve months. More time was required for substitution of large tibial cortical grafts than for grafts or chips of cancellous bone. However, a long time was required for the spongy bone to form a firm fusion. After a Hibbs fusion about fourteen months elapsed before dense bony union was demonstrable on the roentgenograms. The graft on the concave side of the curve became very dense and thick. Grafts over the convex side were atrophied, and in some cases disappeared.

In many instances the correction of spinal curvature was lost in a few months after the removal of the immobilizing plaster cast. This loss of correction was frequently associated with visible pseudarthrosis of the grafted area. However, progressive bending of dense grafts was observed in several cases in which the scoliosis increased without visible pseudoarthrosis.

The authors summarize their findings as follows:

1. Growth of the fused segment in young patients was absent or minimal, except when pseudarthrosis occurred.

2. Pseudarthrosis was related to the mobility of the fused spinal segment, and to the extent of the fusion. It was very common in fusions of the lumbar spine, but infrequent in fusions of the thoracic spine alone. Spontaneous closure of the pseudarthrosis was often observed when the scoliosis became stabilized.

3. In idiopathic thoracic and thoracolumbar and in paralytic thoracolumbar curve patterns, short fusions of the main curve and one vertebra above and below it gave the most satisfactory results.

4. Increase of the scoliosis following spine fusion was seen when the fused area was either too long or too short. In extensive fusions, increased scoliosis was associated with pseudarthrosis, bending of the graft, or with addition of more vertebrae to the curve. Where fusion did not reach the end of the curve, increase occurred above or below the fused segment.

Twenty-five roentgenograms; 3 photographs; 1 chart; 2 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Importance of X-Ray Diagnosis for the Operative Treatment of Prolapse of the Intervertebral Disks. Arnold Hofmann. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 73: 442-453, August 1950. (In German)

The experience gained in over 350 operations performed at the Hafenkrankenhaus, Hamburg, involving the various types of ruptured disks is discussed in detail. The advantages and disadvantages of the x-ray procedures used in myelography are commented upon and the different contrast media are compared. Abrodil is recommended as a contrast medium. Pantopaque was not available to the author.

Twelve figures, including 15 roentgenograms.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Anomalies of the Lumbosacral Vertebrae in Five Hundred and Fifty Individuals Without Symptoms Referable to the Low Back. John D. Southworth and Solomon R. Bersack. *Am. J. Roentgenol.* 64: 624-634, October 1950.

The authors reviewed the six-hour gastro-intestinal films of 550 patients in Mt. Alto Veterans Hospital (Washington, D. C.), none of whom had symptoms referable to the low back. All the roentgenograms were analyzed with respect to the following normal variations, anomalies, and derangements: size of the transverse processes of L-3 to L-5, plane and symmetry of the articular facets, spina bifida occulta, sacralization, lumbarization, lumbar ribs, scoliosis, and arthritis.

Asymmetry of the lumbar articular facets is said to be mechanically undesirable and it has been stated that when the asymmetry is of severe degree, symptoms are produced in practically every instance. However, in spite of the fact that, theoretically, these asymmetrical articulations should not work, a substantial number of persons born with these anomalies enjoy satisfactory function. Fifty-four of 233 patients under the age of forty in the present series had asymmetrical posterior articulations either at L4-5, L5-S1, or at both levels. None of the 54 patients had scoliosis or arthritis, and none had symptoms.

The authors found a 16 per cent incidence of spina bifida in the sacral vertebrae, and 2.2 per cent in the lumbar spine.

Thirty-five patients had sacralization of the last lumbar vertebra and 11 had lumbarization of the first sacral vertebra. Thirty-four of 300 patients had first lumbar ribs. Scoliosis was present in 66 of 300 cases and arthritis in 47. Lumbar scoliosis was found to have no relation to age. There was no increase in lumbar arthritis in symmetrical and asymmetrical sacralization or in spina bifida.

Five roentgenograms; 5 tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Transformation of an Acute Osteomyelitis of the Spine into a So-Called "Bland" Osteomyelitis Because of Insufficient Penicillin Therapy. Otto-Hermann Seydewitz. Fortschr. a. d. Geb. d. Röntgenstrahlen 73: 574-581, October 1950. (In German)

A case originating as an acute osteomyelitis involving the first, second, and third lumbar vertebrae and treated with underdosage of penicillin was followed for a year and a half. Symptoms subsided but the resulting bland osteomyelitic changes gradually spread upward to the fourth dorsal and downward to the first sacral segment without skipping any of the vertebral bodies. The probability of a paravertebral abscess to account for this type of spread is considered likely.

On x-ray examination the signs of this type of reaction are indicated by gross irregularity of the vertebral border, destruction of the intervertebral disks, irregularity of the epiphyseal plates, and sclerosis of the bodies, with lack of marked hypertrophic or reactionary changes such as bridging, spur formations, etc.

[Familiarity with this "bland" process and the possibility of its development following insufficient penicillin therapy may be well worth bearing in mind.—E. W. S.]

Six roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Unusual Fracture-Subluxations of the Shoulder Joint.

Frederick R. Thompson and Edward M. Winant. J. Bone & Joint Surg. 32-A: 575-582, July 1950.

An infrequently recognized type of subluxation of the shoulder joint, associated with fractures of the surgical neck, has been observed at St. Luke's Hospital (New York City). The head of the humerus teeters on the lower margin of the glenoid and is usually displaced somewhat anteriorly as well as distally. The subluxation is seen in association with fracture of the surgical neck, or with combined fractures of the surgical neck and greater tuberosity, simulating fracture of the anatomical neck. It occurs both in the adduction type of fracture of the surgical neck which results from a fall on the lateral aspect of the elbow, and also in the abduction type in which the shaft is angulated outward from a fall on the medial aspect of the elbow or forearm. This fracture-subluxation should be differentiated from a true fracture-dislocation of the shoulder. It does not require manipulative reduction or open operation to replace the head in the socket. The authors now have treated 18 cases, 6 from the Fracture Service at St. Luke's Hospital, representing an incidence of 20 per cent among cases of fracture of the surgical neck. It is believed that this figure would be

higher if routine roentgenograms were taken in both the anteroposterior and lateral positions with the patient standing, especially if horizontal gravity exercises were performed to relieve muscle spasm.

The authors believe that fracture-subluxation is an entity and should be so classified, representing the primary stage of a fracture-dislocation of the humeral head with partial tearing of the capsule.

Treatment is discussed.

Eighteen roentgenograms.

Anomalies of the Carpus, With Particular Reference to the Bipartite Scaphoid (Navicular). Richey L. Waugh and Russell F. Sullivan. J. Bone & Joint Surg. 32-A: 682-686, July 1950.

Developmental variations of the human carpus are unusual. The most common is the bipartite navicular; less common are the os centrale and the fusion of two or more carpal bones. Usually these anatomical variations are bilateral and there is no history of injury.

The bipartite carpal navicular is of special interest to the surgeon because the condition is often mistaken for an ununited fracture. This mistake is not at all surprising when one considers that (1) the line of division between the parts of a bipartite scaphoid is usually at the "waist" of the bone, which is frequently the site of an ununited fracture; (2) the examiner fails to consider variations of the carpus; and (3) a roentgenogram of the opposite wrist is often not obtained.

The division plane of a bipartite carpal scaphoid is usually transverse or slightly oblique. The roentgenogram usually reveals a clear space between the two portions of the bone; the edges are smooth and regular and usually no arthritic changes are present. Associated arthritic changes may be expected, however, in the wrist joint (traumatic osteoporosis of the carpal bones) in certain individuals who in the past have subjected their wrists to undue stresses and strains, i.e., trauma short of fracture.

Two cases of bipartite carpal navicular are reported; in each instance the anomaly was first mistaken for an ununited fracture. In one patient there was a history of injury, and a rheumatoid arthritis was present.

Four roentgenograms.

Congenital Dislocation of the Hip. Development of the Joint After Closed Reduction. Erik Severin. J. Bone & Joint Surg. 32-A: 507-518, July 1950.

The development of arthrography has made it possible to study features of the infant hip joint formerly inaccessible to observation. An ordinary roentgenogram shows only the shape and position of the ossified portions of the joint. Since in early childhood large areas of the femoral head and acetabulum are still cartilaginous, only by injecting contrast material into the joint space can the articulating surfaces of the joint be visualized.

The author has found arthrography to be particularly useful for the study of congenital dislocation of the hip, as it permits strict differentiation of dysplasia, subluxation, and dislocation. Study can be made of the shape and size of the femoral head, the cartilaginous roof of the acetabulum, the adaptation of the head to the acetabulum in different positions, and the width of the capsular isthmus. One can also see whether or not the ligamentum teres is present.

Details and interpretation of arthrograms of the

hip have been discussed by the author in previous publications (*J. Bone & Joint Surg.* 11: 304, 1939. *Abst. in Radiology* 34: 126, 1940; *Surg., Gynec. & Obst.* 72: 601, 1941. *Abst. in Radiology* 38: 380, 1942). Here he presents a series of 115 cases of congenital dislocation of the hip, 38 of which were bilateral and 39 unilateral, all treated by closed reduction during the years 1937 to 1940. Arthrograms were taken at the time of reduction in all cases, both in order to verify the diagnosis and to study the primary effect of the reduction. In one-third of the 115 cases, one or several arthrograms were also taken during the course of treatment. Most of the patients were treated before the age of three, and all before the age of five. In 2 cases, the treatment was begun before the child was a year old. In 72 cases, it is now possible to judge the clinical and roentgenographic results five years or more after the reduction. Results in these cases are classified as follows: well developed hip joints, 24; moderate deformity of the femoral head, neck, or acetabulum in an otherwise well developed joint, 7; dysplasia, but not subluxation, 14; subluxation, 27 (only slight in 21 cases); femoral head articulating with secondary acetabulum, 0; redislocation, 0.

The author believes that closed reduction is the method of choice in congenital dislocation of the hip and that open reduction should be reserved for the few cases in which closed reduction is unsuccessful.

Thirty-two roentgenograms.

Congenital Dislocation of the Hip. Part I. Method of Grading Results. William K. Massie and M. Beckett Howorth. *J. Bone & Joint Surg.* 32-A: 519-531, July 1950.

Because congenital dislocation of the hip cannot be reproduced in the experimental animal, its problems must be approached by studies of adequate numbers of patients observed for a sufficient period of time to justify conclusions. The experiences of many clinics must be pooled.

Forty-four cases of congenital dislocation of the hip (58 hips) treated at the New York Orthopaedic Hospital by open reduction have been followed until the patients reached adult life, and the results have been evaluated. The findings serve as the basis for a report divided into three parts, of which this is the first.

Evaluation of results is dependent upon the accuracy and scope of the method used, and a comparison of the results in different groups of cases is dependent upon a system of grading which can be used by different observers in various clinics with a relatively small margin of error.

The authors' system was devised, first, to include a large number of separate findings; second, to include only those factors which were considered basic and effective at all stages in the development of the joint. The system can be used independently by other observers and affords a high degree of accuracy and comparative value. The evaluations of symptomatic (subjective) findings, physical (objective) findings, and roentgenographic (anatomical) findings are graded separately on the basis of a percentage of normal, each symptom and sign being allotted a rational, although admittedly debatable, percentage of the total. The personal variations in evaluating pain, for example, are included in the symptomatic rating only, which is, therefore, the most inaccurate. The grading of the physical findings can be standardized fairly accurately.

The roentgenographic standards are based for the most part on definite, easily determined measurements. Each measurement applies to any stage in the development of the hip, and the normal values tabulated have been selected from the literature and checked by the authors from a series of normal roentgenograms.

No roentgen measurement is a mathematical certainty, because slight positional variations affect the readings, and films made in various clinics or at widely separated periods in the same clinic nearly always show positional variations. Careful measurements, however, still give a grade which is considerably more accurate than a compilation of all available facts into a general clinical impression.

Each hip in the authors' series was graded roentgenographically in four periods: before reduction, two years after reduction, at puberty, and in early adult life after all hip-joint epiphyses had closed. The hips were not graded symptomatically and physically in the early periods, because all essential data were not obtainable from the records in each period in every case.

Symptomatic rating represents a percentage of normal derived from totaling the grades of the four components: hip pain, low-back pain, fatigue, and activity. Physical rating expresses a percentage of normal and includes such physical findings as are completely objective. Roentgenographic rating is derived from an evaluation of the factors shown in the roentgenogram which are thought to contribute basically to the function of the hip and which would be related to progression of symptoms through attritional or degenerative changes. However, in order that the comparison of hips in patients of various ages or the same hip at various stages of development may be most valuable, osteoarthritis is omitted as a factor in grading. Also omitted are a number of minor factors possibly having some influence on the outcome, but the evaluation of which involves technical errors that would invalidate the entire grade.

Hence, a hip with severe arthritis secondary to a previous avascular change might receive a high grade if the basic structure of the joint remained good. Therefore, when it is thought that the degenerative changes are sufficient to influence function (that is, moderate or severe arthritis), a symbol is placed after the roentgenographic rating. In computing the final results, the grade of hips so marked is reduced by 50 per cent. Omitting arthritis as one of the basic factors does not nullify the usefulness of the grading, because much information can be gained from comparing these basic factors, the degenerative changes being disregarded for the time being.

The factors considered basic, with their ratings, are as follows: (a) size of the femoral head or capital epiphysis (5 per cent of total); (b) anteversion (femoral torsion) (5 per cent); (c) shape of femoral head (20 per cent); (d) obliquity of the acetabular roof (acetabular index) (20 per cent); (e) CE angle of Wiberg (50 per cent).

Six roentgenograms; 1 drawing; 1 chart; 6 tables.

Legg-Perthes Disease. A Method for the Measurement of the Roentgenographic Result. Clarence H. Heyman and Charles H. Herndon. *J. Bone & Joint Surg.* 32-A: 767-778, October 1950.

The deformity incident to Legg-Perthes disease consists of any or all of several components. The epiphysis is commonly flat and broad, and may expand

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beyond the acetabulum. The neck may be correspondingly broad and also short. With more severe deformity, an enlarged head may be inadequately covered by a supporting acetabular roof, which subsequently becomes worn to an obliquity, making the acetabulum broad and relatively shallow. Although more or less flattening of the epiphysis is present in any case of deformity, this is not necessarily the dominating feature.

Since no single component of the deformity is characteristic of Legg-Perthes disease, the authors propose to express the whole picture of the shape of the head, neck, and acetabulum as a comprehensive mathematical quotient. They make four sets of measurements.

(1) The epiphyseal index is the proportion of the height of the epiphysis to its width at the epiphyseal line, and is used to measure abnormalities of the shape of the epiphysis. In order to avoid a fraction, this is multiplied by 100. Measurements are made of both hips and a quotient is obtained by dividing the epiphyseal index of the abnormal hip by that of the normal one. Quotients are similarly obtained in the case of the other measurements. These are: (2) the head and neck index, *i.e.*, the proportion of the length of the head and neck of the femur, measured through the center of the neck to the intertrochanteric line, to the width of the neck at its narrowest diameter; (3) the acetabular index, or relation of the depth of the acetabulum to its width; (4) the acetabulum head quotient, measuring the disproportion of the size of the head in relation to the acetabulum or lateral displacement of the head from the depth of the acetabulum.

Assuming that each of the components of the deformity is of equal importance the authors average the quotients obtained from the previous figures to obtain a comprehensive quotient. They feel that this is a better method of expressing the general picture of the hip than giving a broad roentgen description. It is not stated how these comparisons are made when both hips are involved.

Seven roentgenograms; 12 drawings.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Further Experience in the Management of Osteitis Condensans Ilii. Frank L. Shipp and G. Edmund Haggart. *J. Bone & Joint Surg.* 32-A: 841-847, October 1950.

Osteitis condensans ilii is a term used to designate a disturbance of the ilium characterized roentgenographically by an increased bony condensation in the articular portion of the ilium, but sparing the sacroiliac joint and the contiguous sacrum. The condition is not infrequently associated with pregnancy.

Anatomically the sacrum tends to rotate forward about a fulcrum situated in the vicinity of the second sacral segment, as a result of the weight of the vertebral column in the erect position. The tendency to forward displacement into the pelvis is resisted by the interosseous and posterior ligaments, which become taut, forcing the ilia closer together. The efficiency of this locking mechanism is impaired in some females in whom the sacroiliac joint lies in the sagittal rather than in the more oblique plane. A further factor interfering with the stability of the articulation is added during pregnancy, when relaxation of the ligaments occurs, with the result that increased strain falls upon the articular surfaces of the bones involved. The

authors believe that the continued pressure upon the articular surface of the ilium thus produced is the cause of the increased condensation seen in roentgenograms.

Chronic low back pain is the chief complaint. The pain is described as radiating to one or both buttocks, but never into the sciatic distribution. It is not aggravated by coughing or straining, but is initiated or enhanced by activity and relieved by rest. There is no night pain. The complaint is seldom incapacitating but usually increases slowly in severity and becomes more or less continuous.

The condition is most often confused with sacroiliac arthritis, especially that of a Marie-Strümpell type. The latter, however, occurs more commonly in males. Furthermore, sacroiliac tests are positive in Marie-Strümpell's disease, but consistently negative in osteitis condensans ilii. An elevated sedimentation rate should make one suspicious of arthritis.

The most important single therapeutic measure is correction of obvious postural defects, where possible. This has been accomplished through training and active muscle exercises, and reduction in excessive weight.

The most significant finding in the authors' study of 100 cases of this disease was that in 6 patients serial roentgenograms disclosed an actual decrease in the degree of sclerosis during treatment.

Ten illustrations, including 5 roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Vascular Foramina and Arterial Supply of the Distal End of the Femur. William M. Rogers and Herman Gladstone. *J. Bone & Joint Surg.* 32-A: 867-874, October 1950.

The authors studied the vascular foramina at the distal end of the femur in 200 adults, 16 newborn infants, and juveniles, as well as in 10 monkeys. The foramina were found to follow a constant pattern. They are classified according to anatomical location as supracondylar, condylar, and intercondylar. Each group forms a perforated area in the bone, called by the authors *area cribrosa vasorum femoris*.

In the intercondylar incisura, between the two upper attachments of the cruciate ligaments, is the intercondylar perforated area, or the *area cribrosa vasorum intercondyloideae femoris*. Centrally located in this area is a group of foramina which may lie in a cylindrical depression 3-8 mm. in diameter. This depression is of interest to radiologists, since it has been demonstrated roentgenographically and has been described non-specifically as an "area of rarefaction." The possibility of its erroneous interpretation as a destructive lesion of inflammatory, traumatic, or neoplastic origin is mentioned.

The course of nutrient arteries within the bone was demonstrated by the injection of radiopaque materials and roentgenograms are reproduced showing the distribution of these vessels. The abundant vascular supply about the lower end of the femur explains the lack of ischemic necrosis after fracture.

Seventeen illustrations, including 9 roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Congenital Metatarsus Varus. Report of 300 Cases. J. Hiram Kite. *J. Bone & Joint Surg.* 32-A: 500-506, July 1950.

Congenital metatarsus varus may be thought of as being a "third of a clubfoot." Cases of this deformity

may be divided into two groups. One group is small and is comprised of the more severe cases, with a strong hereditary tendency and associated congenital deformities. Only 9 patients in this group have been seen at the Scottish Rite Hospital for Crippled Children, Decatur, Ga. All had fixed valgus of the heel. The deformity was resistant to treatment and could not be corrected by months of casts and wedgings; operative treatment was required in most instances. All of these patients had some recurrence of the deformity after correction, and in several a second operation was required.

It is with the second and larger group that the present paper is concerned. Patients in this group exhibit no hereditary tendencies or allied deformities other than those associated with the feet, and they have no fixed deformity of the heel. The condition responds readily to treatment and shows little tendency to recur. It is being seen with increasing frequency. Of 300 cases of congenital metatarsus varus studied by the author, 51 per cent were bilateral. An associated clubfoot was present in 13 patients.

The most characteristic finding in these cases is the adduction and inversion of the fore part of the foot. The arch is higher than normal. The more advanced cases have a prominence on the lateral border of the foot. The heel is so nearly in the mid-line that it is almost impossible to tell whether it is in varus or valgus position, but certainly it is not in fixed valgus. Absence of equinus deformity separates these patients from those with congenital clubfoot.

There is congenital muscle imbalance, but in only 94 of the 300 cases reported here was the deformity recognized at birth. The adduction and inversion become more marked during the first few months of life, due to the strong pull of the anterior tibial muscle. The deformity increases with lapse of time, as with deformities following poliomyelitis.

Roentgenograms show varying degrees of adduction of the fore part of the foot. There is usually valgus deformity of the heel, as evidenced by a wide separation of the anterior end of the calcaneus and the head of the talus. When anteroposterior films are made with the fore part of the foot supinated, there is apparent bowing of the metatarsals, due to the slight normal convexity of the metatarsals toward the dorsal surface. The metatarsals appear straight when the foot is placed flat. There is considerable delay in the appearance of the centers of ossification for the first and second cuneiforms. The first cuneiform may be small, and the first metatarsal articulates with the medial side of the first cuneiform instead of being directly in front of it. The small first cuneiform may account for the concavity of the medial border of the foot at this site. The remaining four metatarsals form an angle with the tarsus of about 45 degrees of medial deviation. The great toe is frequently more separated from the second toe than normal.

Another finding of significance, which has only recently been recognized, is that the center of ossification for the navicular is lateral to the head of the talus in a flat-foot position. This center appears when the child is between eighteen months and four years of age. In congenital clubfoot the navicular is medial to the head of the talus.

Six criteria are necessary to make the diagnosis. From the functional point of view, the foot is always pulled in and up; and from the structural point of view,

there are adduction and inversion of the fore part of the foot, a higher arch than normal, a prominence on the lateral border of the foot, and greater rigidity of the foot, which cannot be abducted past the mid-line.

The method of treatment of congenital metatarsus varus varies with the severity of the deformity. Seventy-seven cases in the present series were so mild that casts were not needed for correction, treatment consisting in having the mother stretch the feet in abduction and in having the child wear "swung-out" shoes. Correction by casts and wedgings is similar to that used for adduction deformity in clubfoot, care being taken not to produce a flatfoot deformity.

Four roentgenograms; 9 photographs.

Flatfoot, with Special Consideration of Tarsal Coalition. Mark B. Coventry. *Minnesota Med.* 33: 1091-1097, 1103, November 1950.

The most common type of flatfoot is simple *flattening of the longitudinal arch*, unassociated with ankle valgus, rigidity, or hypermotility, and unaffected by weight bearing. Except for a depression of the longitudinal arch, no roentgenographic changes are present. This condition is a symptomless, non-pathologic individual characteristic. If the patient has foot pain it is due to some other cause.

Relaxed flatfoot is characterized by a short tendo achillis, ankle valgus, flattening of the longitudinal arch, and a medial prominence of the foot. Hypermobility of the midtarsal joints is present. Radiologically the talus is seen to be placed medially and inferiorly on the calcaneus. A lateral deviation of the fore part of the foot on the talus also occurs. Relaxed flatfoot exists from childhood, but pain does not occur until adolescence.

Rigid flatfoot, except in a few cases of tarsal arthritis resulting from rheumatoid arthritis, infection, or trauma, is due to tarsal coalition, *i.e.*, the union of one or more tarsal bones. This union may be fibrous, cartilaginous, or bony, and may occur between the calcaneus and the talus, between the calcaneus and the navicular, or rarely, between other bones.

Tarsal coalition is congenital, and produces symptoms in the teens. The anomaly causes flattening of the longitudinal arch, a medial prominence of the tarsus in the region of the head of the talus, and ankle valgus. The arch of the foot is not affected by weight bearing.

In cases of tarsal coalition, roentgen studies are valuable. Routine studies will reveal the presence of calcaneonavicular coalition. For the demonstration of calcaneotalar coalition, the author recommends the "coalition view" of Harris and Beath (*J. Bone & Joint Surg.* 30-B: 624, 1948. *Abst. in Radiology* 53: 613, 1949). The patient stands on the film and bends slightly forward. The tube is aimed from above and behind the patient, downward at a 45-degree angle toward the film. By this means, obliteration of the sustentaculum tali-talar joint can be demonstrated. In cases of calcaneotalar coalition, routine studies will often reveal spurring of the anterior-superior lip of the talus, and a fuzziness of the subtalar joint when compared with the normal foot.

Treatment is discussed and a number of case reports are included.

Eleven figures, including 19 roentgenograms.

Seven photographs; 1 drawing.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Simple Adapter for Mounting Head of X-Ray Tube to Fracture Table. Morton H. Leonard, Louis W. Breck, W. Compere Basom, and Herbert S. Loseff. *J. Bone & Joint Surg.* 32-A: 950-952, October 1950.

The authors contrived two different sets of bushings for adaptation to two different fracture tables. The adapters are designed to receive the upright of one of the commercial shock-proof portable tube heads, so that the tube can be moved in three directions. This has proved to be a successful way of getting good lateral roentgenograms during hip pinning. Such flexibility is not present when the tube is fixed on a sacral rest. Adapters for use with other fracture tables can be constructed on the same principle.

Seven photographs; 1 drawing.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Considerations on the Subject of Diagnosis of Posterior Hernia of the Intervertebral Disk. P. Glorieux. *Acta radiol.* 34: 299-308, October-November 1950. (In French).

The literature on myelography, including types of examination and technic, is discussed. Myelography is indicated to make a certain diagnosis of herniated nucleus pulposus, and is especially indicated where clinical diagnosis is uncertain, or where more than one nerve root seems to be involved. To be considered in differential diagnosis of herniated nucleus pulposus are: tuberculosis, fracture, hypertrophy of the ligamenta flava, and beginning spondylolisthesis.

Three roentgenograms. CHARLES NICE, M.D.
University of Minnesota

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography in the Study of Sterility. Albert W. Holman. *West J. Surg.* 58: 523-531, October 1950.

Of the many abnormal changes which may be diagnosed by hysterosalpingography, the author considers two in particular, either of which may play a major role in sterility, namely the juvenile uterus and abnormal changes in the cervical canal.

In the hysterosalpingogram the immature uterus is characterized by an abnormally long cervix, which is sometimes conical and sometimes tubular in shape. Normally the adult cervix bears a rough proportion to the body of 1 to 2. In the immature organ the length of the cervix is in reverse proportion to the body, at least 3 to 1. Abnormal changes in the cervical canal include web-like bands obstructing the lumen, hyperplasia of the mucosa, polyps, and strictures, all demonstrable roentgenographically.

Of 350 patients in whom hysterosalpingography was done for sterility, 86 were found to have cervical polyps, hyperplasia, strictures, or stenoses; in 75 the tubes were absent or diseased; 19 had immature uteri; in 170 the findings were normal. One hundred and fifty-two patients were considered suitable for treatment. In 93 of these (61 with apparently normal uteri and 32 with minor cervical abnormalities) the only treatment in addition to hysterosalpingography consisted of such adjunctive measures as cauterization for cervicitis, thyroid medication when indicated by basal metabolism tests, and correction of retroversion of the uterus. Of this group, 56 subsequently became pregnant. Three of the patients with immature uteri received stilbestrol, and all became pregnant.

The author concludes that "this study gives some evidence that hysterosalpingographic investigation aids in the diagnosis and treatment of some cases of sterility." It would seem to the abstractor, however, that the supplementary treatment renders difficult any real evaluation of the therapeutic value of hysterosalpingography.

Ten roentgenograms.

EDSAL S. REED, M.D.
University of Louisville

THE GENITO-URINARY SYSTEM

Radiographic Diagnosis of Perinephric Abscess. Raymond E. Parks. *J. Urol.* 64: 555-563, October 1950.

As used by the author the term perinephric abscess includes not only infections confined to the true perinephrium (i.e., the fatty tissue contained within Gerota's fascia) but also those extending into the paranephric tissues. The incidence of the condition has been given as 0.2 of all urologic cases (Le Comte: *J. Urol.* 56: 636, 1946). It may occur at any age, though it is most common between thirty and fifty years. About one-half of the patients have coexisting renal disease or give a history of instrumentation or previous surgery of the urinary tract on the involved side. Bilateral abscesses are rare. The onset is usually insidious with vague complaints, though some patients present a typical picture of fever, chills, and flank pain, with a tender bulging flank and leukocytosis.

Roentgenography affords the most valuable means of preoperative diagnosis. The author advises the following studies: excretory urography, bilateral retrograde pyelography, fluoroscopy, and roentgenography of the chest, and in special cases, examinations of the spine, ribs, and gastro-intestinal tract.

The most important roentgenographic signs are fixation of the kidney, present in about 90 per cent of cases, and evidence of an extrarenal mass. Loss of the psoas shadow and curvature of the spine have no definite diagnostic value unless supported by more significant findings. If displacement of the kidney is not apparent on the excretory urogram, it may be shown on the retrograde film. A lateral film is particularly useful for this purpose, as it will reveal anterior displacement of the kidney and ureter, indicating a renal or perirenal mass. Immobility of the kidney may be determined by comparing its position in the supine and erect film and by a double exposure, in inspiration and expiration. The normal range of motion as shown by both methods is 2 to 6 cm. Loss of the kidney outline may be observed in about 50 per cent of cases. Function is normal unless there is renal disease or unless the perinephric mass produces obstruction either by direct compression or by displacement of the kidney. In rare cases extravasation of radiopaque material into the abscess may be observed.

The chest should be examined also, as pulmonary disease may produce signs and symptoms of perinephric abscess, or the thoracic contents may be involved by perinephric suppuration. Motion of the diaphragm should be checked. Elevation and fixation of the diaphragm with flattening anteriorly favor the diagnosis of subphrenic abscess, whereas, elevation and fixation with flattening posteriorly are more in favor of perinephric abscess.

In some cases laminagraphy may be helpful in demonstrating perinephric masses. Air insufflation of the

perinephric space has also been used, but this procedure may produce serious complications.

HENRY C. BLOUNT, JR., M.D.
University of Pennsylvania

Cystourethrography in the Diagnosis of Diseases of the Prostatic Urethra. Robert C. Thumann, Jr., and David Randall. *Am. J. Roentgenol.* 64: 640-648, October 1950.

The value of cystoscopy in the diagnosis of diseases of the bladder and urethra is well established. Many findings are encountered, however, which may be misinterpreted and frequently there are undesirable complications following the procedure. When prostatic enlargement is extensive, all portions of the bladder are not visualized with the cystoscope. The urethra and bladder cannot be seen as a whole but only in sections. The size of the prostate gland is at times difficult to determine.

In present-day prostatic surgery the size of the prostate and its mode of obstruction are important in determining the type of surgical procedure to be employed. The cystourethrogram provides a means of showing the lobes involved in hyperplasia and gives an adequate estimate of the size of the gland.

The technic of cystourethrography is outlined and the normal urethrogram is described. The various terms employed to denote changes encountered in pathological lesions of the vesical neck are defined and illustrated by means of excellent plates.

Nineteen roentgenograms; 2 photographs.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

A New Cysto-Urography and Transurethral Operating Table: Hydraulic Operation Providing Prompt Wide Range Position Change. Frederic E. B. Foley. *J. Urol.* 64: 622-631, October 1950.

The author describes in detail a new table of his

design which incorporates most of the features of the original Foley and Sisk tables plus refinements which provide a wide range of position change and which facilitate cystoscopy, pyelography, and transurethral operations.

Six photographs.

JOHN F. GIBBONS, M.D.
University of Pennsylvania

FOREIGN BODY LOCALIZATION

Accidents of Dental Origin. Oral Prostheses in the Respiratory and Alimentary Systems. Ralph W. Edwards. *Arch. Otolaryng.* 52: 88-95, July 1950.

The author points out the difficulty of demonstrating roentgenographically oral prostheses made of the newer plastic materials when these have found their way by accident into the respiratory or alimentary tract. The materials utilized have a very low degree of radiopacity and unless porcelain teeth or metallic bars and clasps are used in association with the plastic prosthesis, the latter may not be visible on the roentgenogram.

Five illustrative cases are presented. In all of these instances, however, some part of the prosthesis was radiopaque.

Seven roentgenograms.

Localization of Foreign Bodies in the Eye by Stereoradiographic Transposition. C. Chaussé. *Acta radiol.* 34: 269-273, October-November 1950. (In French)

A method is described by which a foreign body in the eye may be located by stereoradiography. A piece of lead is placed 1.0 cm. in front of the eye. The geometric relations of the lead in relation to the foreign body as seen by stereography is shown, and a table is given relating the displacement of the piece of lead to the location of the foreign body.

Two illustrations.

CHARLES NICE, M.D.
University of Minnesota

RADIOTHERAPY

Radiotherapy of Cerebral Tumors. D. den Hoed. *Acta radiol.* 34: 309-318, October-November 1950. (In French)

The material presented consists of 186 intracranial tumors seen over a period of thirty years. Histologic structure has a distinct effect on radiosensitivity. Metastatic tumors have the least favorable prognosis. In general patients with glioblastoma survive less than two years. Meningiomas and craniopharyngiomas do not seem to profit much by treatment. Astrocytoma, oligodendroglioma, neurofibroma, and angioma present a more favorable prognosis, due largely to slow growth. Medulloblastoma and ependymoma are more radiosensitive; these tumors also implant along the spinal canal, and it is necessary to irradiate the spine.

Most of the tumors in this series were treated by surgery followed by irradiation; if a tumor were inoperable irradiation alone was used.

A beam of 180 to 200 kv. filtered by 0.5 to 1.0 mm. Cu was employed. In large tumors, two large fields (15 × 15 cm.) were used. In the absence of a preliminary surgical decompression, therapy is started with smaller doses, 100 to 150 r measured in air. When tolerated, a dose of 200 r is given daily. The total dose is 2,000 to 3,000 r per field, measured in air. This series

takes about one month. The patient is observed for two or three months and the series is repeated. After this, irradiation is given only in case of dire necessity.

Pituitary adenomas constituted about 25 per cent of tumors, and for these irradiation is the therapy of choice. About 1,000 to 2,000 r in air is given to three smaller fields. This dose may be repeated in a few months. In chromophile tumors a stabilization of the disease or amelioration of symptoms is all that is to be expected.

Ten tables.

CHARLES NICE, M.D.
University of Minnesota

Results of Irradiation in Cancer of the Lip, Tongue and Ear. L. H. Garland and Merrell Sisson. *Calif. Med.* 73: 312-316, October 1950.

The authors believe that the cosmetic and functional results of irradiation of epidermoid cancer of accessible sites are in general superior to those obtainable by other means.

When there is clinical evidence of limited lymph node involvement, surgical removal of the nodes is usually indicated. If involvement is extensive or the nodes appear to be inoperable, irradiation provides temporary control in a fair number of cases and per-

manent arrest in a few. The authors do not advocate prophylactic node dissection. Lesions which recur centrally after previous irradiation are usually best treated by excision or electrocoagulation; marginal recurrences or recurrences after inadequate dosage may sometimes be cured by radical re-irradiation.

The results obtained at the San Francisco Hospital and in the authors' private practice from 1932 through 1948 are presented:

Cancer of the Lip: Of 121 patients, 105 had a full course of treatment, consisting of fractionated roentgen therapy (100 to 200 kv.; h.v.l. 1.0 mm. Al to 1.0 mm. Cu, depending on the thickness of the lesion), 200 to 500 r daily for a total dose of 4,000 to 6,000 r, in air, in one to four weeks. The five-year arrest was 80 per cent. For lesions with metastases there is only a 25 per cent chance of five-year arrest (irradiation followed by excision of involved nodes).

Cancer of the Tongue: Of 71 patients, 57 completed treatment. External roentgen therapy was given to skin tolerance (approximately 3,000 r to each side), followed by intraoral roentgen or radium therapy to an estimated tumor dose of 5,000 to 6,000 r in four weeks. In 35 cases treated prior to 1944 there were 6 known five-year arrests (17 per cent). Lesions in the anterior two-thirds of the tongue can be controlled in about 50 per cent of the cases if the nodes are not involved. With nodal involvement the salvage is only 15 per cent. Lesions in the posterior third of the tongue are seldom controlled, in the authors' experience.

Cancer of the Ear: Of 25 patients 23 completed treatment. Basal-cell lesions predominated. The technic was similar to that for lip lesions. Primary arrest was obtained in all 23 cases, but only 2 patients were traced for five years, one with arrest and one with recurrence. Extensive lesions are best treated by surgery, as irradiation does not offer superior cosmetic results in this region and there is danger of late chondronecrosis. Five-year arrests should be obtained in about 80 per cent of basal-cell tumors and in about 60 per cent of squamous-cell growths.

Six tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

A Case of Squamous Epithelioma of the Tongue in a Young Woman, Aged Nineteen Years. Richard Flynn and H. Harris. *M. J. Australia* 2: 548-549, Oct. 7, 1950.

A girl of nineteen years was admitted to the Royal Prince Alfred Hospital in Sydney, Australia, in July 1941 with a lesion on the under surface of her tongue which had been present for two months. Examination revealed an ulcer about an inch in diameter on the under surface of the left side of the tongue some 1-1/2 inches from the tip. The patient gave no history of smoking; Wassermann, Kline and dark-field tests were negative for spirochetel infection. Biopsy showed squamous-cell epithelioma.

Eight radium needles were inserted, straddling the lesion—three of 4 mg., four of 2 mg., one of 1 mg.—being left in place from July 15 to July 21. The specific dosage is not given. Two months later the patient was admitted to the hospital with palpable nodes in the neck and a radical resection on the left side of the neck was carried out, followed in several weeks by a similar resection on the right side. One month following the resection a dose of 700 r was delivered by external roentgen therapy to each side of the neck.

The patient has been followed at intervals of six months since that time without evidence of disease. The last examination was made in August 1950.

Two clinical photographs.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Palliative Treatment of Advanced Mammary Cancer. Charles Eckert and William B. Seaman. *S. Clin. North America* 30: 1435-1445, October 1950.

Although radical mastectomy is the treatment of choice in cases of operable carcinoma of the breast, 60 to 80 per cent of all patients eventually require palliative therapy. The three principal methods of treatment available for these patients, either alone or in combination, are surgical intervention, irradiation therapy, and the alteration of hormonal balance.

The use of surgical measures in the management of primary inoperable cases or in cases of local recurrence or distant metastasis is limited.

Irradiation can be employed for either curative or palliative purposes. While its value for palliation has been firmly established, its curative merits are disputed. The authors do not employ preoperative irradiation and believe that postoperative irradiation should be limited to areas where there is reason to believe that residual tumor is present. Irradiation is the method of choice for primary inoperable cases and for the treatment of recurrences and metastases.

Prophylactic sterilization, which has been widely used following surgery in premenopausal cases of breast cancer, is not advocated by the authors. While they agree that pregnancy following cancer of the breast is contraindicated, they believe that pregnancy can be avoided by means other than sterilization. They do not feel that satisfactory proof of benefit from prophylactic sterilization has been presented.

The therapeutic use of castration in premenopausal women with advanced mammary cancer will result in improvement in about 30 per cent of cases. The use of vaginal smear for control when irradiation is employed should obviate the differences in end-results when surgical castration and roentgen castration are compared. If roentgen therapy is used, adequate dosage is imperative.

Androgens may be used in any age group and have been of value in bringing about symptomatic improvement, particularly relief of bone pain. Testosterone propionate has its chief use in cases where x-ray therapy can no longer be employed and as an adjunct to irradiation.

The use of estrogens in premenopausal women has been followed by acceleration of the disease process and their employment should be limited to postmenopausal cases. These substances have been particularly valuable in patients with soft tissue lesions, but improvement of osseous metastases may also occur.

In a few cases of advanced mammary cancer where pain is uncontrollable, nerve sectioning procedures may be required.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Wilms' Tumor. An Analysis of 39 Cases Seen at Duke Hospital in the Past Eighteen Years. David W. Goddard. *South. M. J.* 43: 906-909, October 1950.

A review of 39 cases of Wilms' tumor seen over an eighteen-year period at Duke Hospital (Durham, N. C.)

is presented by the author. The treatment has not been uniform and is still regarded as in the process of evolution, but the following general principles are now observed: (1) postoperative roentgen therapy in all cases treated surgically; (2) palliative roentgen therapy in most inoperable cases, that is, those already showing metastasis; (3) preoperative roentgen therapy only in those candidates for operation whose tumors are too large for removal without a definite increase in operative risk.

The x-ray dosage recommended for these tumors by the radiological department of the hospital [the author is himself a urologist] is 4,000 r preoperatively and postoperatively through two ports, anterior and posterior (200 kv., 50 cm. distance, 0.5 mm. copper filtration).

Of the 39 patients, only 8 are still alive, indicating the high casualty rate. The two-year survival rate is 15.6 per cent, with survivals of 16 years, 14 years, 10 years, 8 years, and 4 years. All these patients were treated by nephrectomy supplemented by irradiation.

The author suggests that there be a closer and more thorough co-operation between the x-ray therapist and the urologist in the management of Wilms' tumors.

Eight tables.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Bilateral Wilms' Tumor. Case Report. John R. Barr and John W. Schulte. *West J. Surg.* 58: 567-570, October 1950.

The authors report a case of simultaneous bilateral Wilms' tumor. A review of the literature revealed 16 previous authentic cases.

The patient was a boy of four and a half years with symptoms dating back one month and an abdominal mass. On examination two distinct masses were felt, one on each side of the abdomen. Pyelograms demonstrated marked enlargement of both kidneys, with deformity and displacement of the calyces. Laparotomy and biopsy led to a diagnosis of Wilms' tumor.

Following a brief period of improvement after roentgen therapy, the course was rapidly downhill. Postmortem examination confirmed the diagnosis, but death was apparently attributable to an acute agranulocytosis due to irradiation. The child had received 1,000 r (in air) to both kidneys anteriorly and 1,800 r to both posteriorly, as well as 1,000 r to each side of the skull for possible intracranial metastases.

Five roentgenograms; 1 photograph; 2 photomicrographs.

HARRY FLAX, M.D.
University of Louisville

Malignant Blood Vessel Tumors. A Report of 56 Cases of Angiosarcoma and Kaposi's Sarcoma. William D. McCarthy and George T. Pack. *Surg. Gynec. & Obst.* 91: 465-482, October 1950.

The authors have collected and analyzed 56 cases of all types of malignant blood vessel tumors from the files of the Memorial Hospital in New York over a ten-year period, in an attempt to clarify this confused field.

Thirty-six of these cases were diagnosed Kaposi's idiopathic multiple hemorrhagic sarcoma. This disease is now considered a true but atypical sarcoma; it usually begins as a single painless bluish-red macule on the lower extremity, looking more inflammatory than neoplastic. Edema may precede the development of the macule, and when present is a bad prognostic sign.

The tumor gradually turns a darker blue, grows in size, and becomes more indurated, while new lesions develop and coalesce in the adjacent skin, often with a stocking or glove arrangement and frequently bilaterally symmetrical. The lymph nodes and viscera may then be involved, with eventual death from cachexia, intercurrent infection, or hemorrhage from metastatic nodules in the gastro-intestinal tract or lungs.

The pathological findings parallel the clinical picture, at first being chiefly inflammatory in nature, later showing variable mixtures of spindle cells and irregular thin-walled blood spaces. In this series, the onset of disease occurred beyond the age of forty in 78 per cent of cases, with the highest incidence in the fifth, sixth, and seventh decades; 92 per cent of the cases were in males and 83 per cent were in persons of Jewish or Italian extraction. The initial lesion was on an extremity in 87 per cent of the cases.

Complete data concerning treatment are not included, but in 3 cases treated by wide excision of the initial local lesion (2 penectomies) the patients were well and free from disease five, six, and nine years after surgery. Surgical treatment is not indicated if the tumors are multiple or extensive, or if edema is coexistent. The disease is relatively radiosensitive, especially in its earlier stages, and will usually regress completely following fairly small doses of irradiation. This is the treatment of choice if the lesions are multiple or if the process is diffusely extensive.

The definitive five-year cure rate of Kaposi's sarcoma was 19 per cent (3 of 16 "determinate" cases), with an average survival, from time of onset, of eight years. Four patients were alive with disease for ten to twenty-five years, all having had radiation therapy.

The remaining 20 cases were diagnosed angiosarcomata. Angiosarcoma usually develops as a firm bulky tumor of deeper soft parts rather than in the skin. It tends to invade muscle, fat, and veins and to encircle the tendons and bones in its path. Growth is moderately rapid; hemorrhagic cavities, necrosis, and mucoid degeneration are common. Pain is a prominent symptom, as contrasted with Kaposi's sarcoma. As with the latter disease, the proportion of Jewish and Italian persons is high (75 per cent) and there is a somewhat similar tendency toward involvement of the extremities (55 per cent).

Angiosarcoma is commonest in the second, third, and fourth decades, 70 per cent of the cases occurring before the age of forty; there is no significant difference in incidence between the two sexes. No five-year cures were obtained by irradiation, surgery, or combined treatment. However, the authors consider immediate amputation the treatment of choice in early cases involving the extremities and irradiation the best treatment for disease originating in the paranasal sinuses. X-ray therapy affords palliative results in many cases, but probably has no influence on the final outcome. The average survival after onset of the disease in this series was two and a half years.

Thirty-one illustrations; 1 table.

WILLIAM C. OWSLEY, JR., M.D.
University of Pennsylvania

Two Cases of Hemorrhagic Telangiectasia. John McD. Glennie. *J. Faculty Radiologists* 2: 165-167, October 1950.

Hemorrhagic telangiectasia is an hereditary disease transmitted as a mendelian dominant, with equal sex

distribution. Telangiectases are seen on a number of mucosal surfaces and are the source of recurrent hemorrhages.

The author reports two cases and advocates application of minimal doses of radiation at suitable intervals to cause obliteration of the vessels without any tissue damage. This procedure produced good results in his 2 patients. A daughter of the second patient was being treated at the time of the report.

Five photographs.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

A Roentgen Apparatus for Intense Roentgen Radiation of Short Duration Intended for Biophysical Research Work and for Special Treatment Purposes. Rolf M. Sievert. *Acta radiol.* **33**: 328-343, March-April 1950.

Equipment in the new high-voltage laboratory at the Institute of Radiophysics, Stockholm, is constructed for experiments with a roentgen tube designed for the following purposes: (1) the study of the biological action of intense irradiation of short duration; (2) the therapeutic application of such irradiation. In the latter case, use is made of arrangements which permit a concentration of the radiation on deep-seated tumors. The apparatus consists of a Cockcroft and Walton cascade generator of 1,200,000 volts, a condenser battery comprising 40 condensers each of 0.11 μ F and a roentgen tube for the use of anodes with very large radiating surfaces. The electron emission in the roentgen tube is produced by means of a large number of wolfram filaments, which are fed with the current from a storage battery giving an effect up to

200 kilowatts. The emission current hitherto used has been of a magnitude of about 2,000 amperes.

Fifteen illustrations.

A Method of Concentrating Roentgen Rays for Deep Therapy (Preliminary Reports). B. Lindell, R. Sievert, and T. Wahlberg. *Acta radiol.* **33**: 344-356, March-April 1950.

Investigation has been made of the distribution of dose under a high-voltage roentgen tube with a conical anode (see preceding abstract), and some preliminary results are reported. Isodose curves have been calculated and are compared with results from dose measurements. A depth dose of 160 per cent has been obtained 8 cm. from the surface in a masonite phantom at a discharge of 200 kv. peak voltage. An electron emission of 1,200 amperes makes possible an irradiation time of only 100 microseconds.

Thirteen illustrations, including 2 roentgenograms.

An Apparatus for Radon Purification. Agnar Egmark. *Acta radiol.* **33**: 311-327, March-April 1950.

A radon-purifying apparatus which involves only physical methods is described. The apparatus is of a semi-automatic type and is operated from a protected location so that the radiation to which the operator is subjected is very small. There are no stopcocks or other movable parts to impede the radioactive gas, and the gas does not come in contact with any substance other than the solution, glass, and mercury. The construction of a motor-driven stopcock and a system for effecting periodically varying pressures are also described. Five figures.

RADIOISOTOPES

I^{131} in the Diagnosis and Treatment of Hyperthyroidism. R. A. Shipley, J. P. Storaasli, H. L. Friedell, and A. M. Potts. *Am. J. Roentgenol.* **64**: 576-589, October 1950.

The normally high affinity of thyroid tissue for the iodide ion is considerably increased in cases of thyrotoxicosis. By means of tracer doses of radioiodine the high uptake and accelerated rate of accumulation which characterize the overactive gland may be measured in several ways. The simplest methods of measurement are by the use of a Geiger counter placed directly over the thyroid and indirect calculation, by urinary assay, of the quantity of the isotope retained.

The authors' studies included 46 hyperthyroid and 15 normal subjects. Tracer doses for normal subjects were 0.1 mc. or less. For patients with hyperthyroidism, doses were 0.25 mc. or rarely, 0.4 mc. Urinary excretion studies showed the mean retention of radioiodine to average 45 per cent (0-70) in normal subjects. In diffuse goiters, retention averaged 84 per cent (36-97), while the nodular glands had a mean retention of 81 per cent (36-97). The fact that there is considerable overlap between normal and thyrotoxic subjects means that radioiodine retention is not a specific test for hyperthyroidism. However, it is of value when performed along with the usual clinical and laboratory procedures.

For therapeutic applications, the dosage was estimated in terms of microcuries per gram of gland of retained I^{131} . Retention was predicted by measurement of the 48-hour urinary excretion of a tracer dose. The

mean dose of radioiodine administered without correction for retention was 7 mc. for patients with diffuse goiter and 13.2 mc. for those with nodular goiter.

In 29 cases of diffuse goiter, the mean dose after correction for the portion lost by excretion was 95 microcuries of I^{131} per gram of thyroid. Of this group of cases, 78 per cent were controlled, 15 per cent did not respond to a single dose, and 7 per cent relapsed. Myxedema occurred in 15 per cent of the cases. The gland usually returned to normal size.

Eighteen cases of nodular goiter were treated with a mean dose of 135 mc. per gram (after correction). Of these, 83 per cent were controlled while 17 per cent failed to respond. There were no cases of relapse or of myxedema. The gland did not, as a rule, return to normal size.

Nodular goiters are relatively tolerant of comparatively large doses of radioiodine. Myxedema is less apt to occur and shrinkage of thyroid tissue is less complete than in patients with diffuse goiters. Another interesting observation was the occurrence of myxedema in cases of diffuse goiter when the apparent retained dose was near or below the over-all average, and yet, higher doses than average in some patients were ineffectual or followed by relapse. Such variations in response are believed to be due to differences in homogeneity of uptake among various follicles of the gland.

Three graphs; 10 tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Use of Radioactive Phosphorus in the Treatment of Carcinoma of the Breast with Widespread Metastases to Bone. Hymer L. Friedell and John P. Storaasli. *Am. J. Roentgenol.* 64: 559-574, October 1950.

The object of this study was to determine the effect of radioactive phosphorus in patients with widespread metastatic carcinomatosis of bone. There is experimental evidence that selective absorption of P^{32} does occur in tumors. Because this selectivity is not great, large doses are required. In the present series of cases, each patient received, on the average, 18.2 mc. P^{32} over a period of forty days. Severe depression of the hematopoietic system was the most important complication of the treatment. After the maximum depression following therapy, the average white blood cell count was reduced to 2,000 cells per cubic millimeter, the red blood cell count was 3.15 million cells per cubic millimeter, and the platelet count was 90,000 per cubic millimeter.

Twelve patients were treated. All had had previous mastectomy and the diagnosis of carcinoma had been established histologically. All had widespread bone metastases, and all suffered severe and continuous bone pain. Most of the patients were being given terminal care. Objective improvement was obtained in 2 cases, as evidenced by recalcification of bone lesions demonstrated roentgenologically. There was relief of pain in all but two instances. Longevity apparently was not increased.

It was the opinion of one of the discussants of this paper (R. S. Stone) that radioactive phosphorus has nothing to offer these patients that may not be given by other less harmful agents now in use (opiates, roentgen therapy, nitrogen mustard, hormones, etc.).

Ten roentgenograms; 3 graphs; 1 radioautograph; 2 tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Use of Radioactive Phosphorus in Studies of Fetal Circulation. Newton B. Everett and Robert J. Johnson. *Am. J. Physiol.* 162: 147-152, July 1950.

A study, with radiophosphorus, of the circulation in fetal guinea-pigs and dogs near term, delivered by cesarean section, indicates that approximately three-fourths of the umbilical vein blood passes through the foramen ovale to the left side of the heart and one-fourth reaches the right ventricle. Approximately three-fourths of the superior caval blood passes to the

right ventricle and one-fourth traverses the foramen ovale to reach the left ventricle. In the fetal guinea-pig, blood from a locus in the umbilical vein passes to the left ventricle slightly in advance of that passing to the right ventricle.

Two tables.

Study of Fracture Healing by Means of Radio-Active Tracers. Hans Bohr and August Halborg Sørensen. *J. Bone & Joint Surg.* 32-A: 567-574, July 1950.

One of the numerous questions connected with the healing of fractures is whether the processes involved are purely local, i.e., limited to the fracture itself and the tissues immediately about it, or whether the whole skeletal system is affected.

In 1939 Roche and Mourgue (*Bull. Soc. chim. biol.* 21: 143, 1939) examined the phosphorus and nitrogen content of different bones of rats and pigeons at various periods after fracture. They found that the phosphorus-nitrogen ratio decreased during the first twenty days and then increased, reaching normal values in about forty to fifty days after the fracturing. These changes were seen not only in the fractured bone, diaphysis as well as epiphysis, but also, although less pronounced, in the intact bones. It was therefore thought that the entire skeletal system acted as a unit and that local influences could be traced throughout the skeleton.

In the present investigation, an attempt was made to follow the changes in a fractured bone and to determine the possible effect of the fracture on the intact part of the skeleton. These studies with radiophosphorus and radiocalcium, administered to rats at different periods during the healing of fractures, showed increased activity of the bone ash from the fractured bone as compared with the ash from homologous intact bone of the same animal. Further investigations indicated that this effect is due mostly to an increased exchange of phosphorus and calcium between the plasma and mineral substance of the bone. Measurements of the separated epiphysis indicate that this process involves the whole bone and the proximal epiphysis of the tibia as well.

Applying these results to the work of Roche and Mourgue, the authors were unable to confirm the belief that the processes taking part in the healing of a fracture can also be found in the skeleton as a whole.

Four tables.

RADIATION EFFECTS—PROTECTION

Pyruvic Acid Metabolism During Normal and Pathological Pregnancy, During and After Anesthesia and Roentgen Therapy. S. Markees, O. Käser, and R. Lanz. *Schweiz. med. Wchnschr.* 80: 1079-1081, Oct. 7, 1950. (In German)

Pyruvic acid occupies an important position as an intermediate product of metabolism. In continuation of their former research, the authors studied its blood levels in certain acidotic and pathological conditions as stated in the title. Under normal metabolic conditions the pyruvic acid blood level is fairly constant, varying, according to different authorities, from 0.5 mg. per cent to 0.95 mg. per cent.

In an uncomplicated pregnancy there is a slight permanent increase in pyruvic acid blood levels from the normal average of 0.8 mg. per cent to 1.3 mg. per cent.

In nephropathies, pre-eclampsia, and eclampsia the blood level is much higher depending upon the severity of the condition, varying from 1.5 mg. per cent to 3.7 mg. per cent.

Twenty-five surgical patients were examined before, six to eight hours after, and sixteen to twenty hours after anesthesia. The values of the pyruvic acid blood levels were doubled from about 1.1 mg. per cent before anesthesia to about 2.1 mg. per cent after surgery. This would indicate that pyruvic acid takes part in post-anesthesia acidosis.

Four patients undergoing roentgen sterilization and 6 treated for carcinoma of the uterus were repeatedly examined for pyruvic acid blood levels. Those undergoing sterilization showed a slight increase of blood levels after the first two treatments; after the third

and fourth treatments the increase was less marked and the subjective feeling of the patient was good. Patients treated for carcinoma of the uterus showed a steady increase in pyruvic acid blood levels, with concomitant signs and symptoms of roentgen sickness, and patients with the highest blood levels showed the most severe reaction. After initiation of vitamin B therapy there was an immediate improvement in subjective feeling and the pyruvic acid blood levels decreased. It is not clear whether this effect is due to a pharmacodynamic action of thiamine and lactoflavin, or whether roentgen irradiation produces a relative avitaminosis. However, it seems evident that in roentgen sickness acidosis plays an important role, and the beneficial influence of prophylactic and therapeutic administration of vitamin B, especially vitamin B₁, in large doses is probably due in part to the action of the vitamin on the pyruvic acid with subsequent diminution of its blood level. In severe acidotic conditions the additional administration of thiamine pyrophosphate (cocarboxylase) is indicated.

Three tables; 1 diagram. JULIAN O. SALIK, M.D.
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X-Ray Protection. Harold F. Batho. J. Canad. A. Radiologists 1: 48-51, September 1950.

In this paper an exposure of 0.3 r per week is taken as the tolerance dose.

The possible sources of x-ray exposure of patients or operating personnel are (a) the useful beam, (b) direct radiation, *i.e.*, radiation transmitted through the tube shield, and (c) radiation scattered from matter in the path of the useful beam.

The operator must never be exposed to the useful beam even with lead gloves and apron. With present day equipment, the radiation scattered from the patient is, in general, more intense than that emerging through the tube head shield. While "ray-proof" tube heads are not ray proof in the strict sense, further shielding would increase their weight without appreciably reducing the total stray radiation. However, all ray-proof tube heads are not necessarily adequately shielded.

Average exposures at different positions in a radiographic room are illustrated. At a distance of six feet or greater from the patient, the probability of exceeding the tolerance dose is small but this should not be taken as justification for staying in the room while films are exposed.

Exposure of technicians working with portable radiographic equipment is considerably higher, due, in part, to the lighter shielding of the tube head. It has been recommended that technicians be limited to 15,000 ma.-sec. of operation per week; if a lead rubber apron is used, this figure may be increased by a factor of five or more. The author recommends the use of a lead apron even though weekly operation is less than 1,500 ma.-sec.

With photofluorographic equipment, exposure of the operator tends to be high and it is advisable that switches be wired and placed so that the tube can be energized only when all operators are protected fully. Without lead protection, the tolerance dose is likely to be exceeded even at 12 or 15 feet from tube and patient.

Average exposures in different positions around a typical fluoroscopic unit are also illustrated. The lead back glass of the fluorescent screen offers adequate

protection in that area. However, the radiologist who persistently places his hand in front of the screen is likely to suffer overexposure even though lead rubber gloves are worn. It is essential that the radiologist wear lead rubber apron and gloves at all times. Exposure of the arms and feet depends on the design of the equipment but is high enough to merit consideration and measurement. In some units a relatively intense beam of scattered radiation emerges from the slot through which the Bucky diaphragm fits. The technician should be in the room during fluoroscopy only when essential, and then should be protected by a lead rubber apron.

Measurements made on a 220-kv. deep-therapy machine showed, as would be expected, that personnel should never be in the room while treatment is in progress. A lead rubber apron reduces exposure by a small factor, perhaps 30 to 50 per cent.

A chart shows the structural shielding necessary with typical diagnostic and therapy units as well as the minimum safe distance without shielding.

The importance of regular routine measurements of the exposure of operating personnel is stressed. Such measurements may be made either with ionization chambers or dental film.

Two illustrations.

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Effect of Beta Irradiation on Gastric Acidity. Raymond F. Hedin, Winston R. Miller, and Demetrius G. Jelatis. Arch. Surg. 61: 748-757, October 1950.

This article is a preliminary report of studies to determine the effect of radioactive phosphorus (P^{32}) on gastric acidity in dogs. The experiments were undertaken to determine whether beta irradiation from P^{32} might be effectively and safely employed in the treatment of peptic ulcer by reducing gastric secretion.

The gastric capacity of the dog was first determined by instilling 20 per cent sodium bromide into a balloon in the animal's stomach. The balloon was then filled to capacity with P^{32} in the form of an aqueous solution of an activated potassium dihydrogen phosphate. The doses of irradiation employed varied from 250 to 10,000 rep in ten dogs.

A striking correlation was obtained between the changes in gastric acidity and the histologic changes in the gastric mucosa after the various doses of P^{32} . It appears that a dosage of 10,000 rep produces a marked reduction in gastric acidity for a prolonged time without complete achlorhydria.

Further studies are being made to decide whether the method might be safely applied to treatment of patients with peptic ulcer.

Eleven illustrations.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Some Cases of Radiation Injury in Radiologic Work. Sven Hultberg and Lars-Eric Larsson, assisted by Lennart Eklund. Acta radiol. 33: 376-387, March-April 1950.

In Sweden all cases of radiation injury are supposed to be reported to the Institute of Radiophysics, which supervises establishments where radiologic work is carried on or where radioactive substances are stored. Five cases of radiation injury among radiologic workers and 3 among patients undergoing roentgen ex-

amination are presented, with a brief discussion of the occurrence of radiation injuries in general and the importance of adequate and rapid investigation of cases in order to secure prompt execution of the protective and other measures needed.

Five photographs.

Features of the System of Periodical Inspection Adopted for Roentgen Therapy Installations in Sweden, and Some Experiences of the Inspection Work. R. Thoraeus. *Acta radiol.* **33**: 253-280, March-April 1950.

Periodical inspection of roentgen therapy installations has been compulsory in Sweden since 1941. The present paper gives an account of the development, program, and organization of this system, the purpose of which is to secure the best possible physical safeguards against errors in dosage, to prevent ill health due to exposure to irradiation in workers in the vicinity of installations, and to give patients reasonable protection from radiation other than that required for their treatment. Protective measures suggested by various inspection experiences are discussed.

Seven illustrations.

On the Use of Radioactive Substances in Sweden, with Special Reference to Irradiation Risks and Protection Measures. Sven Benner. *Acta radiol.* **33**: 281-295, March-April 1950.

The use of radioactive substances for medical, scientific, industrial and other purposes in Sweden is discussed, chiefly from the point of view of radiation protection. Some devices designed at the Institute of Radiophysics, Stockholm, for improving protection in radium therapy are described. These include, among others, radium safes, radium work benches, and carts for radium transport.

Eleven illustrations.

A Simple Instrument for Radiation Protection Measurements. L. Lorentzon and T. Wahlberg. *Acta radiol.* **33**: 305-310, March-April 1950.

The authors describe an instrument for radiation protection surveys built on photometric principles, the fluorescent light from a fluoroscopic screen being compared to the light from a field illuminated by an electric lamp. The instrument permits the measurement of radiation dosage rates at a large number of points in relatively short times. The accuracy of the procedure is, in most instances, fully sufficient for protection measurements. Where more exact results are required, the instrument is a valuable complement to measurements with an ionization chamber, for example, making possible a rapid preliminary survey to find those points where an accurate determination is desirable.

The instrument has proved very useful in detecting minor radiation leakages. A direct image of the leakage is obtained on the fluoroscopic screen and often the leakage is accurately localized (for example by placing a small metal rod in different positions in front of the instrument). This detection method, therefore, not only enables the actual radiation dosage rate to be measured, but also provides information as to the best way of repairing possible defects in the protective devices.

The greatest demand for sensitivity of instruments measuring radiation intensities normally arises from protective measurements at roentgen installations being operated for a long time at low power (e.g., installations for therapy and fluoroscopy). Here it is possible to detect radiation doses of 0.1 r for a week of about sixty working hours, assuming the lowest measurable dosage rate to be approximately 0.5 μ r per second.

The instrument has also proved itself useful for estimating radiations of very short duration, such as exposures of 0.05 second but, when possible, measurements at longer exposures are to be preferred.

Three figures.

Proposals for the Establishment of Swedish Regulations on Roentgen Ray Protection Made at the Request of the Institute of Radiophysics. Thor Wahlberg. *Acta radiol.* **33**: 364-375, March-April 1950.

For about ten years all radiologic work in Sweden has been supervised by the Institute of Radiophysics. Through regular inspection and other means, the Institute strives to obtain the best possible radiation protection conditions in the various establishments. The regulations and instructions necessary from the point of view of protection are issued in each individual case. Although this procedure has generally proved to be satisfactory, there has arisen an increasing need for regulations of more general application.

The proposals presented here are based on experience from more than 8,000 inspections of roentgen installations and are mainly founded on the principle that no person, except when undergoing roentgen treatment or examination, should be exposed to radiation above a certain limit. This limit has been set at 0.1 r per week. The dose mentioned applies to whole body irradiation as well as to irradiation of parts of the body, with the exception of peripheral parts such as the hands and the forearms, for which 1 r per week is permitted. Unnecessary irradiation of patients should be avoided. Special caution should be observed when irradiating the sex organs, children, and pregnant women.

Instead of stipulations on a maximum allowed dose, the proposals give some general rules which, although lacking the character of strict regulations, should nevertheless be observed. The regulations contain only the fundamental demands of radiation protection. Comments, advice, and instructions have been separated from the regulations proper, so that they can be amended and added to with less formality.

On the Possibility of Protecting the Living Organism Against Roentgen Rays by Chemical Means. Arne Forssberg. *Acta radiol.* **33**: 296-304, March-April 1950.

An account is given of attempts to protect living organisms against the effects of roentgen rays. Cysteine, added to bacterial cells immediately before irradiation, was found to afford some protection to the culture from irradiation injury. Other sulfhydryl-containing chemicals acted similarly, but this was not true of related chemicals without a sulfhydryl group. Cysteine injected into the skin of guinea-pigs more or less prevented epilation after otherwise epilating doses of irradiation.

Five illustrations.

